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Science & Technology

Central Eurasia: Space

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CONTENTS

25 March 1993

MANNED MISSION HIGHLIGHTS

SPACE SCIENCES

INTERPLANETARY SCIENCES

SPACE ENGINEERING

SPACE APPLICATIONS

SPACE POLICY, ADMINISTRATION

Crew Rotation on Mir Space Station

Cosmonauts Continue Experiments, New Crew To Launch 24 Jan 92

937Q0079A Moscow ITAR-TASS in English 1052 GMT 22 Jan 93

[Text] Moscow January 22 TASS—The scientific part of the program, implemented this week by the cosmonauts Anatoliy Solovyev and Sergey Avdeyev at the Mir orbital complex, included astrophysical, geophysical and technical experiments.

According to the information of the Mission Control Center, they have conducted numerous experiments on extra-atmospheric astronomy, using the international orbital observatory Roentgen. Its telescopes have been trained since January 12 on a powerful source of Roentgen radiation in the Vela constellation.

Several series of experiments were conducted with the help of the instruments installed on the outer surface of the Mir orbital complex. The purpose of the experiments was to obtain information about the intensity of space irradiation, the micrometeorite flows and the radiation situation in the near-earth space.

Preparations for the launching of the Soyuz TM-16 spacecraft are going on at the Baykonur space launch complex. The launching is scheduled for 08.58, Moscow time, of January 24.

Final Preparations Begin for Launch of New Crew to 'Mir' Station

937Q0079B Moscow TELERADIOKOMPANIYA OSTANKINO TELEVISION FIRST PROGRAM NETWORK in Russian 1500 GMT 22 Jan 93

[Video report by Petr Orlov; From the "Novosti" newscast]

[Text] A rocket for the new crew for the "Mir" station has been mounted at a Baykonur launch position. But there are no engines for the next six rockets—they are manufactured in Zaporozhye [Ukraine]. In this position, the cosmodrome is getting ready for the first manned launch this year. The cosmonauts have their last day off before the flight. Tomorrow, one of the crews will be approved by a state commission, and early in the morning on Sunday they will take their place in the spaceship.

There are no particular worries that the launch will not go normally, but the cosmodrome services have less and less optimism about the immediate future. As long ago as last year, Russia was still leading in the number of launches, but for several months it has not received final permission from Kazakhstan authorities to deliver to the cosmodrome a new freight ship to supply the orbital station.

The military of various ranks think that the documents on space signed by CIS leaders and by Russia and Kazakhstan separately, with what appears to be a favorable attitude toward the subject, have not produced anything else but more uncertainty.

The leadership of the military space forces have yet again invited to the launch parliamentarians and government representatives from Russia, Kazakhstan, and Ukraine. But if again they only see the invariably fascinating launch scene and the best hotel in the town of Leninsk, it can hardly be expected that anything will change for the better here. [video shows: last preparations at launch site]

Soyuz TM-16 Spaceship To Be Launched 24 Jan

937Q0079C Moscow ITAR-TASS in English 23 Jan 93

[Article by Rena Kuznetsova]

[Text] Moscow January 23 (TASS)—A Soyuz TM-16 spaceship with the main crew on board is to be launched on Sunday morning—at 08.58 Moscow time [0558 GMT], a spokesman at the Mission Control Center told ITAR-TASS.

On Saturday the four cosmonauts are at the Baykonur cosmodrome, preparing for an expedition to the orbital complex Mir. The first crew consists of Gennadiy Manakov and Aleksandr Poleshchuk and the back-up crew includes Vasiliy Tsebliyev and Yuriy Usachev. Out of the four cosmonauts, only Colonel Manakov worked in orbit from August to December 1990.

The peculiarity of the forthcoming flight is that for the first time over the entire period of the orbital station's stay in space docking will be carried out by means of a general-purpose androgynous docking assembly positioned on the Kristall module. The docking will be unusual also because it is to be done manually. Previously an automatic mode was the main option for this responsible operation, Mission Control Center experts told ITAR-TASS.

On board the orbital complex, the arriving crew are expected by Anatoliy Solovyov and Sergey Avdeyev—participants in the 12th main expedition—who have been working in orbit since 27 July, last year.

Work of New Mir Crew To Include Deploying 'Sail' in Space

937Q0079D Moscow RADIO ROSSII NETWORK in Russian 1500 GMT 23 Jan 93

[Text] In spite of all the problems we have on earth, the Mir station is continuing its work in space. Come February it will have been in use for seven years. Over these years the equipment on board Mir has worn out and become obsolete. The last few crews have had to spend quite a lot of time and energy just keeping the station in a normal operational condition. When the orbital station was designed, the plans allowed for a 10-year service life. So, the orbiting station continues to function. The time has come to rotate crews. Anatoliy Solovyov and Sergey Avdeyev will return to earth in early February. They have spent six months in orbit. Gennadiy Manakov and Aleksandr Poleshchuk will take their place in space. Journalist Anna Kiseleva will talk about the new crew and their work program:

[Kiseleva] In accordance with established tradition the crew commander, Manakov, is a military man. This will be his second space flight. Flight Engineer Poleshchuk is a civilian. This will be the 13th orbital expedition. It will blast off from the Baykonur Cosmodrome on the morning of 24 January.

One of the most interesting stages of the Manakov-Poleshchuk expedition will come two days after the launch, when their Soyuz TM-16 spacecraft docks with the orbiting station. During this operation the cosmonauts will use the versatile androgynous, a peripheral docking unit which was last used in 1975 during the joint Soviet-U.S. Soyuz-Apollo space project. Extremely great significance is being attached to the testing of this androgynous unit, so the docking will be a completely manual operation—the first occasion on which this has been done in recent times. The docking experience will come in useful this fall when the U.S. space shuttle will dock with the Mir Station. Specialists reckon that this androgynous docking unit is quite likely to be used in various space projects.

A unique situation will be created on the Mir space station when the docking takes place on 26 January. There will then be three spacecraft docked to it—two Soyuz modules for the cosmonauts and the Progress freighter which arrived last fall.

Gennadiy Manakov and Aleksandr Poleshchuk will stay in orbit until July. During those six months they will carry out a number of medical, technological, and astrophysical research projects, some of which are international ones. For instance, they will continue effective experiments in which French equipment is being used. Among other things the crew's predecessors will be leaving them an interesting experiment called Banner [Znamya]. Several expeditions have already tried but failed to make a success of this experiment. The cosmonauts will be trying to deploy a thin, metal-coated film shaped like a sail and then to monitor its behavior in the weightless conditions of interstellar space. If the outcome is successful, such a film could be used like a gigantic reflector to beam light to earth, at times when it is dark here. The higher latitudes could benefit from this during the polar night, for instance.

[Announcer Belov] The testing of complex new technologies at all stages of space flight, from design and assembly of spacecraft on factory floors to orbital research, is certainly not a simple process. After all, the aim is not just to accomplish a successful launch, to reach orbit, and then return home after completing several dozen research projects. It is also important for them to come up with new technologies, materials, and designs which are essential for the progress of life on earth. But this is the ideology, the strategy of space exploration. The immediate tactical move is Sunday's launch of the 13th space expedition to work in orbit.

Crew To Use Buran Module For Docking

937Q0079E Moscow TELERADIOKOMPANIYA OSTANKINO TELEVISION FIRST PROGRAM NETWORK in Russian 2100 GMT 24 Jan 93

[From the "Novosti" newscast: Video report by Petr Orlov, identified by caption]

[Text] [Orlov over video of Manakov and Poleshchuk in launch vehicle]. Since this morning the new Mir station crew—Gennadiy Manakov and Aleksandr Poleshchuk—are on their way to the orbital complex. They will replace Anatoliy Solovyov and Sergey Avdeyev who have spent six months working in space. The docking between the spacecraft and the station is scheduled for Tuesday [26 January]. An option which has not been used before was chosen this time. The docking module intended for Buran is to be used. For the time being specialists are not claiming that Buran will arrive at the station in a year's time as announced previously. Nonetheless, despite the financial difficulties, preparations on the reusable spacecraft are continuing at Baykonur. Meanwhile, Manakov and Poleshchuk will test the main component of this project—the docking mechanism. Afterwards, the cosmonauts will remain at the station for the next six months with an extensive program, including spacewalks. In July they will be joined for three weeks by a Frenchman, and together they will complete the program of this main expedition, which is the 13th in number.

Soyuz TM-16 Launched

937Q0079F Moscow ITAR-TASS in English 0630 GMT 24 Jan 93

[ITAR-TASS correspondent Rena Kuznetsova]

[Text] Mission Control Center January 24 (TASS)—The Soyuz TM-16 spaceship was launched from Baykonur cosmodrome at 08.58 [0558 GMT] today with cosmonauts Gennadiy Manakov and Aleksandr Poleshchuk on board.

Following the spaceship's docking with the orbital complex Mir, they are to replace the crew of the 12th main expedition—Anatoliy Solovyov and Sergey Avdeyev who have been working in orbit since July 27, last year.

The flight is proceeding normally and the cosmonauts are feeling well, a spokesman at the Mission Control Center told ITAR-TASS.

Biographies of Soyuz Cosmonauts Noted

937Q0079G Moscow ITAR-TASS in English 0839 GMT 24 Jan 93

[ITAR-TASS correspondent Rena Kuznetsova]

[Text] Moscow January 24 TASS—The Soyuz TM-16 spaceship was launched from Baykonur cosmodrome on Sunday morning with cosmonauts Gennadiy Manakov and Aleksandr Poleshchuk on board.

The spaceship's docking with the orbital complex Mir is scheduled for January 26. After that the two crews will spend several days together. Then the new arrivers will replace the "old hands"—Anatoliy Solovyov and Sergey Avdeyev—who will return to Earth.

The mission commander is Colonel Manakov, 42. He already worked in orbit from August to December 1990. He was born in Yefimovka village of Andreyev district in Orenburg region. He began to prepare for space flights among a group in 1988. From September 1992 he underwent training as a commander of the main crew for a flight on board the versatile orbital complex Mir. He has mastered 42 types and modifications of flying vehicles, logged a total of 1,620 hours of flying time and had 248 parachute jumps. He is a first-class test pilot.

Aleksandr Poleshchuk, a test cosmonaut of the Energiya Research and Production Association, was born in the town of Cheremkhovo, Irkutsk region, in 1953. The flight engineer of the crew has gained wide experience in test work under simulated weightlessness conditions.

Since September last year he has been preparing for a space flight as a flight engineer under the program of the 13th main space expeditions.

From March to July 1992 he underwent training for a space flight on board a Soyuz TM transport spacecraft and the orbital complex Mir as a flight engineer of the back-up crew of the 12th main expedition and of the Russo-French international crew.

Soyuz TM-16 Space Mission Continuing

937Q0079H Moscow ITAR-TASS in English 1057 GMT 25 Jan 93

[Text] Mission Control Center January 25 TASS—The space flight of the Soyuz TM-16 spacecraft with Gennadiy Manakov and Aleksandr Poleshchuk on board is going on.

During the first 24 hours they conducted planned operations for checking the functioning of the on-board systems of the spacecraft and the air-tightness of its compartments. In addition, they conducted a planned maneuver of a long-distance rendezvous with the Mir manned orbital complex.

At present the parameters of the spacecraft's orbit are as follows:

—maximum distance from the earth's surface—308 km,

—minimum distance—257 km,

—period of revolution—89.9 minutes,

—inclination of the orbit—51.6 degrees.

The cosmonauts Anatoliy Solovyov and Sergey Avdeyev have a day off today. They are conducting no experiments Instead they are doing physical exercise, training with the help of the pneumatic-vacuum spacesuit Chibis and getting prepared to welcome the Soyuz. The docking is expected to take place at 10.38 on Tuesday.

Soyuz TM-16 Docks With 'Mir' Orbital Complex 26 Jan

937Q0079I Moscow ITAR-TASS in English 0813 GMT 26 Jan 93

[ITAR-TASS correspondent Rena Kuznetsova]

[Text] Moscow, January 26 TASS—The Soyuz TM-16 spaceship, manned by Gennadiy Manakov and Aleksandr Poleshchuk, the crew of the 13th expedition, has just docked with the orbital complex Mir.

The spaceship was launched from Baykonur cosmodrome on January 24.

Anatoliy Solovyov and Sergey Avdeyev, the crew of the 12th long-duration expedition have been working in orbit since July 29, last year.

Further on Docking With Mir Complex

937Q0079J Moscow ITAR-TASS WORLD SERVICE in Russian 0840 GMT 26 Jan 93

[Text] Moscow, 26 Jan (ITAR-TASS)—The Soyuz TM-16 spacecraft docked with the Mir orbital complex at 1031 Moscow time today, the Flight Control Center has reported.

This is the first time a ship has docked with the Mir complex at the Kristall technical module. The module has two universal androgynous-peripheral docking units which make it possible to dock with space apparatus with a mass of up to 20 tons, including shuttles.

The program for the joint flight of cosmonauts Solovyov, Avdeyev, Manakov, and Poleshchuk includes performing a number of scientific-technological and medical-biological experiments and handing over to the crew of the 13th main expedition.

On 1 February Anatoliy Solovyov and Sergey Avdeyev will return to Earth on the Soyuz TM-15 craft and work on board the Mir manned complex will be continued by Gennadiy Manakov and Aleksandr Poleshchuk.

TV Report on Docking With Mir Station

937Q0079K Moscow TELERADIOKOMPANIYA OSTANKINO TELEVISION FIRST PROGRAM NETWORK in Russian 1800 GMT 26 Jan 93

[From the "Novosti" newscast: Video report by Petr Orlov, identified by caption]

[Text] [Video opens with view of space craft in orbit.]

[Announcer] At 1031 hours today the new crew arrived on board Mir.

[Orlov] The Soyuz TM-16 cut its engines and approached the Mir station. Crew Commander Gennadiy Manakov, judging by the brief comments that were made, clearly enjoyed controlling the craft manually, just like back in his pilot days. He and flight Engineer Aleksandr Poleshchuk are the first men to dock with the station here, where the Buran orbital craft is going to dock. Their cosmonaut colleagues at the Flight Control Center remarked that such a docking requires a very high level of skill from the crew. The controllers were effectively experiencing a new form of operation because equipment like this has not been used at all since the days of the Soyuz-Apollo mission. The designers recalled that the docking system used by this crew could become standard for the whole world and, when necessary, could facilitate the rescue of other countries' cosmonauts when they are in distress. But the leadership of the Energiya Science and Production Association stressed that such a docking unit has already been offered to the Americans for use with the space station Freedom: It is working successfully today, and this increases the opportunities for cooperation, which would be of material benefit to all. But the people most pleased with the meeting are the two crews: Anatoliy Solovyov and Sergey Avdeyev, because their tour of duty is coming to an end. Gennadiy Manakov and Aleksandr Poleshchuk because they are going to spend the next six months in orbit. But for the time being, until 1 February, the crews will be on board the station together.

[video shows orbiting space station, docking, flight control center, spacecraft blueprint, cosmonauts entering spacecraft, performing exercises].

Cosmonauts Determine Dynamic Parameters of Space Complex

937Q0079L Moscow ITAR-TASS in English 1447 GMT 28 Jan 93

[Text] Moscow January 28 TASS—Today the Russian cosmonauts will carry out an experiment named "Resonance" aimed at determining the dynamic and durability characteristics of the research complex "Mir" assembled in orbit and consisting of seven space units. The mass of this composite space system is over 100 tons, a spokesman for the Mission Control Center told ITAR-TASS.

In the course of implementing the geophysical experiment "Susha" (land) including a video survey and spectrometry of the earth's surface, Anatoliy Solovyov and Sergey Avdeyev will help Gennadiy Manakov and Aleksandr Poleshchuk, who flew to the complex two days ago, master and specific features of the television controlled platform of the "Kvant-2" module.

Judging by reports from orbit and telemetric data, the flight is proceeding according to schedule.

Cosmonauts Prepare To Return to Earth

937Q0079M Moscow ITAR-TASS in English 0940 GMT 29 Jan 93

[ITAR-TASS special report from Mission Control]

[Text] Moscow January 29—Friday is the fourth day the crews of the 12th and 13th expeditions work together on board the scientific-research complex "Mir."

Today, preparing to return to earth, cosmonauts Anatoliy Solovyov and Sergey Avdeyev will undergo a comprehensive cardiovascular check-up using the "Chibis" pneumatic suit. Gennadiy Manakov and Aleksandr Poleshchuk will work with equipment, on-board systems and scientific devices.

An experiment studying the development of higher plant life continues according to a biological research project. Another experiment on board the space station is attempting to master methods of cultivating plants in zero-gravity.

All of the cosmonauts are in fine health, according to medical check-ups.

Mir Cosmonauts Obtain Hybrid Cells for Use in Pharmacology

937Q0079N Moscow ITAR-TASS in English 1107 GMT 30 Jan 93

[Text] Mission Control Center January 30 TASS—The four cosmonauts continue working on board the orbital research complex Mir. Anatoliy Solovyov and Sergey Avdeyev are to undergo regular training on Saturday with the use of pneumatic-vacuum space suit Chibis and check the onboard systems of the Soyuz TM-15 spaceship in which they are to return to earth on Monday.

Gennadiy Manakov and Alexander Poleshchuk are engaged in the technical maintenance of equipment and instrumentation of the orbital station.

The cosmonauts completed a program of biotechnology experiments. Using the recomb installation, they obtained hybrid cells that will be used in pharmacology as producers of new antibiotics and other medicinal preparations. The cosmonauts also performed experiments to study the effect of weightlessness on the genetic system of biologically active substances.

Telemetry data and reports from orbit indicate that the flight is proceeding according to program.

Soyuz TM-15 Lands in Kazakhstan 1 Feb

937Q0079O Moscow ITAR-TASS WORLD SERVICE in Russian 0434 GMT 1 Feb 93

[Text] Moscow, 1 Feb—The descent vehicle of the "Soyuz TM-15" spaceship has just completed soft landing in Kazakhstan. Anatoliy Solovyov and Sergey Avdeyev, members of the 12th long-term mission, have returned to Earth. They have spent almost six months in the "Mir" orbital complex.

Gennadiy Manakov and Aleksandr Poleshchuk, their successors who arrived at the station on 26 January, continue their work.

TV Reports Cosmonauts' Landing, Comments on Upcoming Flights

937Q0079P Moscow TELERADIOKOMPANIYA OSTANKINO TELEVISION FIRST PROGRAM NETWORK in Russian 1800 GMT 1 Feb 93

[From the "Novosti" newscast: Video report by Petr Orlov and Vladimir Avdeyev, identified by caption]

[Text] [Announcer to camera] The crew of the 12th main expedition to the Mir station returned to Earth today. Cosmonauts Solovyov and Avdeyev may be congratulated on a soft landing. Let me remind you: They have spent almost six months in orbit.

[Orlov over video of aircraft on tarmac in a blizzard, followed by shots of air traffic control room, and helicopter in flight]

Leaving a snow storm behind in Kustanay, and obtaining the "go ahead" for the departure from Arkalyk, our camera team, overflying power lines and cow sheds in a helicopter trying to dodge low, icy clouds, arrived at the touchdown site after Anatoliy Solovyov and Sergey Avdeyev had alighted from the descent module. The latter was lying half-way between the hillock from which it had rolled down on landing and a semi-frozen marsh. Mercifully, it had come to a halt some 150 meters short of the marsh. Right there in the steppe, a new record for the Guinness Book of Records was registered. Solovyov and Avdeyev had worked, together with Manakov and Poleshchuk who remain in orbit, on the biggest space complex ever built outside the Earth—three craft, that is to say, three modules, plus the Mir station basic unit.

Against the backdrop of this and many other things that have been achieved in space, the existing landing system

looks more and more like an anachronism which saps the last bit of strength of those returning to Earth after six months of hard work.

Specialists claim that aerospace systems like the Shuttle or Buran are more humane. However, cosmonauts cannot count on them in the next few years. Participants in the next few expeditions are well aware of this—that is those preparing jointly with the French for the expedition in July, and also the doctor who is getting ready for an 18-month stint on the Mir station.

Petr Orlov, reporting for Novosti from the cosmonauts' landing site.

[Announcer] Briefly about future flights. In November a unique expedition to Mir in terms of length will begin. It will last 18 months. The manned spaceflight program also includes plans for a woman-cosmonaut to take part in one of the long expeditions. [video shows aircraft on tarmac in blizzard conditions, air traffic control room, helicopter en route for landing site, views of the landing site, post-flight shots of cosmonauts in spacesuits siting in the open, in track suits inside cabin, and standing up being congratulated against the backdrop of an aircraft].

News Conference at Conclusion of Space Flight

937Q0079Q Moscow ITAR-TASS WORLD SERVICE in Russian 1656 GMT 3 Feb 93

[ITAR-TASS correspondent Rena Kuznetsova]

[Text] Moscow, 3 February—During the space flight which lasted from 27 July 1992 to 1 February 1993, a series of scientific, technical, technological, medico-biological, and astrophysical research projects and experiments was conducted, said Yuriy Glazkov, head of the Center for Cosmonaut Training, at a press conference held in Zvezdnyy Gorodok today. He introduced to journalists Anatoliy Solovyov and Sergey Avdeyev, the crew of the 12th main expedition who came back two days ago. For example, a series of observations was completed as part of the international astrophysical research project "Roentgen." A long-term experiment entitled "Condor" was carried out, the purpose of which was to ensure constant monitoring of the radiological situation, taking into consideration neutron radiation in the premises of the manned complex.

Sergey Avdeyev told journalists at the news conference that during the expedition chicks hatched out from quail eggs in the station. The experiment, performed on the Incubator-2 biotechnological equipment, was aimed at studying embryological development of birds in conditions of weightlessness.

At the moment the crew members are under strict supervision of doctors who report that the readaptation period of the participants of the protracted expedition is proceeding normally.

Solar Reflector Deployed in Orbit

Deployment of Solar Reflector Planned for 4 Feb

937Q0080A Moscow ITAR-TASS in English 1406 GMT 3 Feb 93

[ITAR-TASS correspondent Rena Kuznetsova]

[Text] Moscow, February 3 TASS—Europeans in various cities might be able to see the Russian "Mir" space station early on Thursday [4 February] if a unique experiment in orbit becomes a success, according to experts of the Mission Control Center.

The experiment will be held in the framework of the "Space Regatta"program aimed at lighting up Russian regions beyond the Polar Circle where the night lasts for eight to nine months, as well as disaster areas by reflecting sunlight to earth.

Residents of Belarusian cities of Brest and Gomel, of Lyons in France, Geneva, Bern in Switzerland, Stuttgart and Munich in Germany, Prague in Czechia and Lodz in Poland might see with the naked eye the "Mir" station and the "Progress-15" cargo ship.

The "Progress" will part from the station and deploy in space a screen with a diameter of 20 meters which will serve as a mirror reflecting the light of the sun to the earth.

If lucky, Europeans might see the "Progress" sparkle for a second. The reflected light will resemble that of the moon.

The experiment will begin at 08.22 hours Moscow time [0522 GMT] and will last for six minutes.

'Mir' Space Crew Carry Out Space Reflector Experiment

937Q0080B Moscow ITAR-TASS in English 1345 GMT 4 Feb 93

[ITAR-TASS correspondent Rena Kuznetsova]

[Text] Moscow, February 4 TASS—The unique "Znamya" experiment has been completed in outer space. A giant sunlight reflector has been unfurled on the orbit. Such structures will be used in the future to light up areas of various accidents, natural calamities and forbidding regions.

The cargo vehicle "Progress M-15" undocked from the "Mir" orbital complex at 3 hours 45 minutes Moscow time to start the experiment. A circular plastic mirror, twenty meters in diameter, was unfurled with its help in outer space. Cosmonauts Gennadiy Manakov and Aleksandr Poleshchuk, working jointly with the Flight Control Center and other ground services, have successfully coped with their task. The "new light" experiment was carried out at dawn today as part of the "Solar Regatta" experiment. Inhabitants of several European cities could see the light beam coming from the "Mir" station. The masterminds and participants of the experiment are unable to say how it all looked, of course. This can be done only by earth dwellers, who happened to watch the phenomenon early today.

This was only the first part of the program, the results of which will eventually open up broad prospects for lighting

up the earth's surface. In experts opinion, the "Solar Regatta" project will eventually help save millions of tons of petroleum.

Orbital Reflector Builders 'Inspired by Success'

937Q0080C Moscow TELERADIOKOMPANIYA OSTANKINO TELEVISION FIRST PROGRAM NETWORK in Russian 1800 GMT 4 Feb 93

[From the "Novosti" newscast: Video report from flight control center by Petr Orlov, Aleksandr Gerasimov, and Nikolay Fedorov, identified by caption]

[Text] [Orlov from Flight Control Center over video of giant sun reflector with caption reading "pictures from space filmed by Gennadiy Manakov and Aleksandr Poleshchuk"]. "This is not 'Znamya' [official name of experiment], this is Phaethon's Chariot!—people at Flight Control exclaimed when the solar sail shaped like a daisy-wheel unfurled and began twirling among the clouds.

The poetic mood which reigned at the Flight Control Center last night is to be explained by the successful beginning of the first experiment in history of building a solar reflector in orbit. The official title of the experiment is "Znamya." The circular screen made of very thin reflector foil unfolded almost exactly as its builders had planned. It responded readily to commands from the Earth. This led to the conclusion that the sail is controllable. And this is what happened as the reflector was passing through the borderline between day and night above Europe. The task was to cast a patch of light along the flight path from Spain to Belarus and thus to prove that lighting the planet from space is possible with larger-scale reflectors. A mere six minutes were set aside for this experiment.

[Orlov] And so, was there a shimmer of light? Cosmonauts Gennadiy Manakov and Aleksandr Poleshchuk are claiming that there was. However, they did not manage to record it with the video camera.

According to unconfirmed reports, a light beam from space was observed in Gomel and Brest. Most probably at least one more experiment will be needed to be able to claim that polar regions and areas of natural and technological disasters can be lit up using this sort of device.

People have already calculated that man-made moons suspended in outer space could help to save substantial amounts of traditional energy resources. In addition, such reflectors could be used as the basis for sizeable antennas in orbit.

But in the meantime, inspired by success, members of the "Space Regatta" Consortium and the Energiya Scientific Production Association are getting ready to collect funds for the next experiment.

Successful Space Solar Reflector Shows Sector's Potential

937Q0080D Moscow IZVESTIYA in Russian 5 Feb 93 p 2

[Report by Sergey Leskov: "Gigantic Mirror in Orbit"]

[Text] Early on the morning of 4 February an experiment was conducted on the Russian "Mir" orbital station, which could overturn our conventional ideas about nature.

A cunningly designed mirror, with a diameter of 20 meters, made out of plastic reflective material only five microns thick, was deployed at a height of around 400 kilometers. The light from the sun was reflected from it onto the planet's surface. The experiment was the first occasion when man has succeeded in artificially concentrating the light of the sun, which is diffused into space and which carries inexhaustible stores of energy.

The idea behind the experiment came form a well-known specialist in the space sector, Professor Vladimir Syromyatnikov, chief designer of docking systems. "The prospects for using solar reflectors are practically boundless," the scientists said. "Solar reflectors can illuminate cities at night and agricultural regions during round-the-clock harvest work. Light from space for Arctic regions is even more relevant. It is important too for natural disaster areas, where normal sources of energy supply have been destroyed. The proposed technology is also advantageous in that it is completely harmless ecologically and requires no expenditure on the construction of ground facilities."

The practical significance of the experiment is confirmed by the fact that it is funded by one of the country's biggest enterprises, "Yamburggazdobycha," which is extracting gas in the Arctic. Not a penny has been spent on the experiment from the space sector's meager budget. At the same time, the project could mean a significant saving in the future. Specialists reckon that a space illumination system for a major urban region will pay for itself in two-three years and could save around two million tons of oil in five years.

On 4 February, before dawn, the spot of light, some tens of meters in diameter, raced across Lyon, Geneva, Bern, Stuttgart, Munich, Prague, Lodz, Brest, and Gomel. According to specialists, the reflector would have been much more effective in Arctic latitudes, but on the first occasion it was necessary to chose the trajectory of the "Mir" station. In no way does this devalue the experiment, because the most important task at the first stage was to check the unique technical design.

There has been much talk recently about the impoverishment of the Russian space sector. There is no need to paint a rosy picture, it has enough problems. But the pioneering "Znamya" experiment shows that the Russian space sector still has great potential. It is interesting that the experiment was originally planned to be conducted in 1992, within the frame work of the international Space Regatta, when space yachts from several countries, driven by the power of the sun's rays, would have reached the Moon. At that time we were expecting to recoup the cost by winning one of the prizes. Unfortunately the regatta idea fell through. But this did not result in the collapse of the "Space Regatta" concern, which includes 15 Russian enterprises, headed by the "Energiya" science and production association

Russia: Mir Crew Change Marks New Phase in Space Program

PM1501155593 Moscow PRAVDA in Russian 14 Jan 93 p 4

[Anatoliy Pokrovskiy report: "Change of Shifts in Orbit, Changes on Earth"]

[Text] The once-mighty Ministry of General Machine Building has broken up, like a rocket after an unsuccessful launch. The small Russian Space Agency (just over 200 people), which is entrusted with shaping and implementing the national space program, the Russian General Machine Building Association, which operates on commercial principles, the Main Administration for the Development and Use of Space Technology for the National Economy and Scientific Research, which has joined the industrial structures, another commercial organization—Kosmoflot [expansion unknown], headed by the cosmonaut German Titov—and an entire asteroid cluster of all sorts of companies and firms are now maintaining independent orbits.

It is hard to say whether they are capable of embracing the whole diversity of modern cosmonautics, but the first and, so far, purely earthly conclusion has already been drawn—the agency does not need the spacious building on Miusskaya Ploshchad, which was constructed during the time of the ministry. It would probably be possible to support this, although the building was specially equipped for operational leadership of the space show, if... Do not be in a hurry, you people on the waiting list, to move into a well-appointed home. There is a more serious claimant—the Committee for Defense Sectors of Industry.

It is amazing how prolific officialdom has become! It has taken over the vast complex of buildings on Staraya Ploshchad and moved into the CEMA tower block and all the premises of former party and Union structures. The former monopolist colossi are being disengaged and broken up, while the army of officials is multiplying all the time, not only taking over buildings which have been vacated but also already squeezing each other.

On the other hand "Baykonur" (PRAVDA wrote about this recently)—like other work places, incidentally—is becoming increasingly devoid of people. So do not be surprised that a strange thought occurred to me on seeing off the new crews for the Mir complex to the launch pad: Gennadiy Manakov and Aleksandr Poleshchuk, as well as Vasiliy Chiblyev and Yuriy Usachev, should be rewarded for valor not after but even before the flight, whose launch is scheduled for 24 January.

Meanwhile, very interesting work faces them right from the moment of docking. They will try out the so-called androgynous (universal) docking assembly, and so they will dock with the Kristall module. It is intended to test this assembly before the meeting with the U.S. Shuttle and, maybe, with our Buran. I would very much like to hope that earthly interference will not affect the successful start of the new crew's work and the happy return of Anatoliy Solovyev and Sergey Avdeyev after their six-month flight. Only, will they recognize their own country after landing on their native planet?"

Plans for Solar Sail Spacecraft Competition

937Q0026A Moscow LATINSKAYA AMERIKA in Russian No 9, Sep 92 pp 47-50

[Article by Vladimir Bazanov, general director, Kosmotekh enterprise: "We Will Bring Together the Efforts of the People of the Planet"; the first paragraph is an introduction]

[Text] The "Columbus 500" international competition has been announced to commemorate the 500th anniversary of the discovery of America. The competition is for the development of spacecraft with a solar sail which under the proposal of its organizers should be launched to the Moon and Mars in the autumn of 1992. Vladimir Bazanov, general director of the Kosmotekh enterprise, tells about this project.

Correspondent: How did the idea of an international space expedition develop?

Bazanov: We will step back a little in history. Space solar craft were known earlier in Russia than in other countries. The idea that sunlight exerts pressure on objects already was demonstrated experimentally by the Russian scientist P. N. Lebedev at the end of the last century. Tsiolkovskiy, knowing his studies, stated that motion in space is possible under the influence of solar energy. Tsander went further: he already demonstrated it theoretically. It is possible, to be sure, to argue with our foreign colleagues as to who discovered and proposed it earlier. Here it is possible to mention Arthur Clark, an American scientific fiction writer, who in his writings expressed the idea of creating geostationary satellites and the flight of space yachts to the moon. However, the idea of a space regatta to mark the anniversary of the discovery of the New World was proposed by the American National Committee for Celebrating the Five Hundredth Anniversary of the Discovery of America. A proposal was formulated calling for an international competition whose objective was the development of spacecraft with a solar sail and organization of a regatta.

Correspondent: Who are the participants in this project?

Bazanov: Under the conditions for the competition all the projects must be implemented on a nongovernmental basis and must be financed from unbudgeted funds. Since cosmonautics and space technology in Russia are completely on a governmental basis, we could not so easily satisfy this condition. Nevertheless, in early 1988 a creative group of enthusiasts was organized and we proceeded to development of a project.

This group for the most part was made up of specialists in the machine building field from the Russian Academy of Sciences and enterprises of the Russian space branch engaged in the development of space technology. The project was competitive. Upon its completion the materials were sent to Vienna, to the representatives of the committee for organization of the competition in Europe, and to Washington.

The conditions for the competition were very interesting. The mass of the spacecraft must not exceed 500 kg.

Correspondent: A symbolic figure.

Bazanov: It was the intention of the organizers of the competition that the three top space solar sail spacecraft should be launched using the resources of the organizing committee using a booster of the Shuttle type. All other craft would be launched at private expense.

About 30 projects from different countries were considered in the competition. There should be three winning spacecraft: one from Europe, from whence the search for a New World began, the second—from Asia, whither the eyes of the Spanish crown and Columbus himself were directed, and the third—from discovered America. The finals in the competition from Europe included a British craft put forward by the Cambridge Consultants company, an Italian project, developed by a group of enthusiasts from the Aerea Italia National Space Agency, and from Russia, a project developed by the Mashinostroyeniye Scientific Production Association jointly with specialists of the Academy of Sciences.

The Americans proposed partial or complete financing for development work and launching support. Those groups which want to demonstrate the erroneousness of the committee decision have the right, at their own expense, by arrangement, to receive a place on the Shuttle and to participate in the race.

However, then some wavering began. In connection with the war in Iraq and the presidential campaign the Americans did not carry through with the regatta.

Correspondent: So has the makeup of the participants been finalized or not?

Bazanov: No. In addition, the use of the Shuttle for the regatta has become extremely difficult and in general a quite costly diversion. One- time use boosters also have now been assigned to the implementation of commercial and national programs. We are proposing use of the nationally produced Proton booster.

Correspondent: Is it possible to use one booster for the launching of all craft?

Bazanov: No, a carrier of the Arienne-4 type is capable of carrying out a launching to the necessary starting point—not less than 2000 km—of three craft with a mass of 300 kg. The Proton is considerably more powerful and can put a payload of up to 2 ½ tons into a geostationary orbit. I would like to draw attention not only to the weight of the payload put into orbit, but also to its volume. Indeed, today the Proton is the sole booster which can really execute the putting of three space yachts into a starting orbit.

It is not necessary to consider the possibility of launching individual craft because here such nuances as the uniformity of the starting orbit already begin to exert their influence. If different boosters are used, a scatter of orbital parameters and a difference in launching time will be observed. Accordingly, it is desirable to use one booster in implementing the space regatta, especially since there is a possibility for putting not less than three craft into orbit simultaneously.

According to the conditions for the competition, the space craft must deploy their sails in circumterrestrial orbit. This

is a structure with an area of several hectares. Inhabitants of the planet will be able to observe them with the naked eye until they have withdrawn a considerable distance from the Earth.

It is proposed that the entire world community participate in this project. Under the conditions of the regatta, the spacecraft must be launched into a circumterrestrial orbit and move in a spiral trajectory toward the Moon, and upon reaching it, drop commemorative capsules and then from the Moon begin motion toward Mars, a flight which will last a year. They should pass in the immediate vicinity of Mars—at a distance of approximately 16,000 km. The possibilities for control of the craft, naturally, are limited because these are racing craft and emphasis will be on optimizing parameters ensuring their maximum acceleration.

Thus, the first stage is putting the vehicles into a circumterrestrial orbit, deploying the sails, then determining who is the first to attain second cosmic velocity and arrive at the moon. This is dependent on the velocity characteristics of each craft. The dropping of commemorative capsules onto the lunar surface is the principal measure and an obligatory condition of the regatta: they must contain information on the people who the different continents have honored: politicians, scientists and cultural figures, and, probably, on the sponsors of the regatta. It is a great honor to be included on this list: everyone on Earth will know about this. In addition, the capsules prepared in Europe will contain the texts of the Old and New Testaments, the Sixth Symphony of Shostakovich, the decimal reckoning schemes developed in Asia, legends and tales.

Correspondent: Will the flight be monitored from some definite center?

Bazanov: Here you have to be specific about what kind of monitoring you mean. About monitoring the craft themselves or about monitoring the course of the regatta? I think that this will be done by each national committee of that country which is participating in the regatta or will be coordinated by the Spanish national committee if it continues its activity even after 1992. But possibly by that agency which will be formed from representatives of the organizations of the countries participating in the regatta. I assume that it also is possible to organize an international office with the participation of several countries on different continents. I know that the Australians and Africans wish to enter space. Latin America also will participate in this project. And all this should occur under the aegis of the UN.

I think that there also are some delicate points here: a race is a race. You always have to take care that your horse is not fed something before leaving the starting gate. I am sure that everything will occur in a quite civilized way. It is even difficult to visualize anything different. And although the conditions of the competition, launching and its date are determined by the rules and regulations drawn up by the Americans, in a further examination of the project it is necessary to conclude a special agreement among the participating countries taking into account the technological possibilities, means for ensuring a launching and technical parameters. As of today there is no such an agreement.

Now a few words as to why we propose the Proton booster for the space regatta. First of all, its technical parameters ensure a capability for simultaneously launching three or four craft, thereby ensuring identical initial conditions for starting of regatta participants. Second, as of today this is the most reliable booster in the world.

Correspondent: When the craft have performed their mission what will happen to them?

Bazanov: The mission of a space solar sail spacecraft is very specific: ensure motion along a stipulated trajectory and implementation of the flight program. After their realization it should penetrate into the surface of Mars, or in a flyby, move on, but then it will already become a body in the solar system, being transformed into a "Flying Dutchman." And, possibly, in actuality these craft will become objects of future study.

Correspondent: Have prizes been set?

Bazanov: The Americans have announced a winning prize for the regatta of 15 million dollars. The sum seems large for us but in actuality it suffices for the winner only to cover his expenses. According to British data, their craft will cost about 14 million dollars; the French craft will cost in the range of 10 million dollars. The Russian program calls for expenditures of about 30-40 million rubles, which is commensurable with the expenditures of the others.

Correspondent: Who is financing the project in our country?

Bazanov: This matter is being solved with considerable difficulty, which is understandable. The task of constructing a solar sail spacecraft must be regarded, first of all, as solution of a purely conversion (of publicly floated state loan) problem because these ships cannot be used in the military field.

Correspondent: It would be possible to draw commercial enterprises into the undertaking.

Bazanov: That's entirely true. At the time when we began the work we did not even know whether it would be possible to use a nongovernmental organization for solution of problems related to space. Now the situation is different: our commercial structures already are quite strong and have means, including funds to invest, which also will enable them to handle this task.

Correspondent: When will such a grandiose event occur?

Bazanov: The launching date still has not been determined. Plans call for late 1993.

Correspondent: How long will the regatta itself last?

Bazanov: If you are talking about the trajectory to the moon—from one to six months, to Mars—up to two years.

To be sure, it would be good if the craft were launched by 12 October of this year so that the era of use of solar sail spacecraft would be off to a start. But here the problem of sponsors arises again. Naturally, the participation of any sponsor in the project will give him a definite image: it is the

strongest, most civilized publicity. We can recall that products with the Olympic symbol during the Olympiad-80 in Moscow cost considerably more. Publicity for the producer of the booster, publicity at the time of launching and during the regatta and advertisement on the spacecraft themselves make it possible to make this project profitable.

Correspondent: Has the structure of technical support for the project already been organized?

Bazanov: Yes, along publicity lines. This applies, first of all, to Glavkosmos, the High Technologies Association and other organizations already participating in implementation of the project. Since plans call for developing a spacecraft of a new type, this also means a new technology, and this alone is attracting development specialists. The new craft are considerably cleaner ecologically speaking than traditional craft. You and I know that circumterrestrial space is littered with the wastes of used-up rocket fuel. However, these craft do not use chemical fuel, but only ecologically clean energy, solar radiation, natural for space. They will assist in solving many problems which cannot be solved using traditional means. As solar sail, I assume, has both a scientific and practical future.

In contrast to the first launchings, when purely scientific and strategic objectives were pursued, when the expenditures on implementing programs were very great, the task of creating a space solar sail spacecraft is today being solved differently. Even the regatta itself must be regarded as flight tests of spacecraft of a new type, as a confirmation of the efficacy of modern technology. In other words, even today a ruble invested in this program may yield a profit. In itself the project is rare with respect to economic efficiency and in actuality it involves the introduction of high technologies.

The future use of the craft also is promising. What do I have in mind? First of all, the regeneration of ozone in the ozone layer. The countries of the southern reaches of Latin America, let's say, the poorly populated regions of Chile and Argentina, especially during the time of the Antarctic winter, experience an ozone deficit. The large cities of these countries, as well, incidentally, as cities in other regions, are not safeguarded from this.

The scientists who are specialists of the Mashinostroyeniye Scientific Production Association, the High Technologies Association and the Kosmotekh enterprise, engaged in solar sail spacecraft technologies, have developed a concept which makes it possible to approach solution of problems relating to ozone layer regeneration.

In addition, it is important to carry out research on our solar system from points situated above the plane of the ecliptic. Spacecraft with a solar sail will make it possible to ensure departure beyond the limits of the plane of the ecliptic and make scientific observations of the solar system. Using such craft it will be possible to predict solar activity and to solve many other problems.

Thus, if one recalls the voyages of Columbus and look at their results, we see that he discovered considerably more than he intended and expected, for example, magnetic declination of the compass. The planned regatta also will make it possible to open a new direction in space technology which will broaden knowledge concerning our civilization. The crews of Columbus's caravels were international and now it is possible to bring together the efforts of the people of all countries in solving the problems in common for our planet.

History of Plesetsk Cosmodrome Recounted

937Q0044 Moscow ROSSIYSKIYE VESTI in Russian 19 Dec 92 p 5

[Article by Konstantin Alekseyev: "The Secret Cosmodrome"]

[Text] This city hasn't been put on the map yet. In its short history, it has already had many names—Moscow-400, Leningrad-500, Angara Facility, the settlement of Lesnoy—and in 1966, it received the status of city and bears the name Mirnyy (although in the press, they still call it "the Plesetsk Cosmodrome," as before).

In January 1957, when Baykonur was being built, a decision was made in this country to build another large rocket complex. The choice of the site was based on the fact that a railroad ran right past and the site was relatively near industrial centers; on the site's high geographic latitude, which would make it possible to put vehicles into circumpolar orbits; and on the fact that the "right-of-way zones" of the rayons along the flight trajectories of the rockets were sparsely populated. There, on the shores of the Yemtsa River, the 53rd scientific research firing range for the Strategic Missile Forces was opened.

The city dates its history back to 15 July 1957, when the first echelon with the builders arrived at Plesetsk Station in Arkhangelsk Oblast. Their lot was harsh conditions—the impassable taiga, marshy terrain, no houses (at first they lived in mud huts and tents, then in small vans). The winter brought hard freezes, two-three hours of sunlight a day, abundant snowfalls. As quickly as possible in that uninhabited land, railroad approach lines and roads had to be laid; production areas, tech areas, assembly-and-testing buildings, and launch complexes had to be erected, an air defense system had to be set up; and housing had to be built. In 1958, the difficulties and the high cost almost put a halt to the project. But reason won the day. Thanks to the titan efforts of the builders and the technical service personnel, the rocket crews, under the command of Col M. G. Grigoryev (later a colonel-general), started their first military duty by 1959. The first ballistic missile (the famous No 7, or R-7, a prototype of the Vostok, Soyuz, and Molniya launch vehicles) lifted off there on 30 July 1959. During the Caribbean crisis in October 1962, units of the firing range were placed on a higher level of alert. With the growth of the firing range, however, the tasks before the rocket crews were not limited to that. Because of the facility's favorable location, it was decided in May 1964 that, besides intercontinental ballistic missiles, the pads would be used to launch artificial Earth satellites. Thus, the firing range received the status of cosmodrome.

In December 1965, an experimental test launch was performed from there, and on 17 March 1966, the Zenit-2 reconnaissance satellite, whose official name was Kosmos-112, lifted off there. After that, more than 1,500 spacecraft were launched from the cosmodrome. They were military satellites (for reconnaissance and communications), as well as strictly civilian satellites. With time, new launch complexes and technical complexes were erected. In terms of number of launches, Plesetsk became No 1 in the world, the "busiest" cosmodrome in the world—a status that was highly honored through awards of the Order of the Red Banner and the Order of the Red Banner of Labor. From its launch pads, the Kosmos-1000, Kosmos-1500, and Kosmos-2000 "jubilee" spacecraft were put into orbit. At present, Plesetsk prepares for launch and sends into space satellites like Bion (for the study of the effect of space factors on living organisms), Resurs (for the study of the Earth's natural resources), Foton (for the production of various materials in microgravity), Musson (for the creation of a unified geodesic system), Okean (for the study of the world ocean), Nadezhda (for the international system COSPAS-SARSAT for rescue of crews of ships and aircraft in distress), the Meteor weather satellites, the Molniyas (which support television and radio communications for the entire country), and multipurpose scientific-research and military Kosmos satellites. Work is under way in international programs (the Interkosmos satellite, the Aureole satellite, the Meteor/TOMS platform, the MAC), and in August 1990, specialists from the U.S. National Aeronautics and Space Administration (NASA) visited the cosmodrome for the first time. And however expensive those launches have been, they have paid their way many times over—without the Molniyas, for example, many regions of the country would be without telephone communications and television, and setting up a ground network would cost a pretty penny.

These days, with the problems involving the use of Baykonur, which is located within another country—Kazakhstan—the value of our northern cosmodrome has grown. In early 1992, B. N. Yeltsin visited it. In his words, Russia needs its own cosmodrome, and it has one. The president of Russia also thanked the staff and personnel at the firing range for their professionalism, for their selfless and successful work, and for their courage.

Elements of the Nonlinear Dynamic Configuration of Space Vehicles Containing Fluid With a Free Surface

937Q0031A Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 35 No 8, Aug 92 pp 49-61

[Article by I. B. Bogoryad, I. A. Druzhinin; UDC 629.78.015.001]

[Abstract] In a study of the dynamics and control of motion of a space vehicle and its booster stages, the mathematical modeling must be adequate for the dynamic interaction of the vehicle and the fluid masses in its tanks. The right side of dynamic equations describing booster stages and a space vehicle carrying fluid masses consist of forces and moments that stem from the action of the mobile fluid on the walls of the fuel tanks. Until now, when programmed motion was being determined, the fluid was considered a solid, with its free surface a plane perpendicular to the longitudinal axis of the facility. Fluid mobility was considered only in a model of disturbed motion. The traditional linear model of the "true" motion of the fluid as the sum of programmed and disturbed motions is justified if the rotational motion of the facility near the center of mass occurs at rather small angular velocities. But if the facility performs a maneuver that is accompanied by large angular displacements at large angular velocities, the model is unacceptable. The researchers here formulate a so-called inertial floating cover model capable of reflecting the nonlinear nature of the fluid's motion. It assumes that the free surface of the fluid in programmed motion does not simply follow the changing direction of the vector of the field strength of the mass forces, i.e., it can effect motion via inertia and remain flat at the same time. Figures 12, references 21: 17 Russian, 4 Western.

Effective Algorithms for the Numerical Modeling of Artificial Earth Satellite Motion

937Q0031B Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 35 No 8, Aug 92 pp 62-70

[Article by T. V. Bordovitsyna, L. Ye. Bykova, A. V. Kardash, Yu. A. Fedyayev, N. A. Sharkovskiy; UDC 629.783:523.31:521.182]

[Abstract] The principal sources of error in the numerical prediction of satellite motion include inadequate accuracy of the approximating formula in the numerical method, the Lyapunov instability of solutions of the systems of equations being integrated, the lack of uniformity of change of the functions of the right sides of equations of motion, and inaccurate physical and mathematical models of affective forces. Over the last 10 years, this group of authors has aimed its efforts at solving theoretical and applied problems associated with computer-based numerical modeling of satellite motion. They have attempted to either eliminate entirely the above-mentioned sources of error or minimize their influence. The work was done on mainframes, as well as PCs. References 6: 4 Russian, 2 Western.

Stellar Spots and IRAS Observations of Late Stars

937Q0023A Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 69 No 4, Jul-Aug 92 (manuscript received 28 Jun 91) pp 821-828

[Article by M. M. Katsova and V. Tsikoudi, State Astronomical Institute imeni P. K. Shternberg; Janina University, Greece; UDC 524.316-76]

[Abstract] Data (January-November 1983) from the IRAS satellite were used in studying objects in the far-IR region, especially K- and M- stars with surface activity. The following problems were examined: correlation between the intensity of radiation in the band 12μm and the observed magnetic fluxes, velocities of axial rotation and interpretation of the correlations. These far-IR observations are compared with the spectra of active and inactive late dwarfs in visible light. There was found to be a small difference

between the observed radiation fluxes in the band about 12μm from the corresponding values characterizing blackbody radiation of these stars. The IR excesses and the corresponding differences of the color indices correlate with the observed magnitudes of the magnetic fluxes. An analysis of the possible mechanisms of the appearance of such IR excesses for these stars (synchrotron radiation, dust particles, surface inhomogeneities) makes it possible to relate this effect to the considerable spottiness of active late K- and M-stars. The magnitude of the relative area occupied by the spots must substantially exceed the values determined from the variability of the radiation of these stars in broad spectral bands or from changes in the profiles of the spectral lines. Figures 3; references 20: 3 Russian, 17 Western.

Results of Determination of Dynamic and Kinematic Parameters of System of Martian Satellites From Observations

937Q0023B Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 69 No 4, Jul-Aug 92 (manuscript received 28 Jun 91) pp 863-872

[Article by N. V. Yemelyanov, S. N. Vashkovyak and L. P. Nasonova, State Astronomical Institute imeni P. K. Shternberg; UDC 521.31]

[Abstract] A study was made of the motion of the Martian satellites and the kinematic and dynamic parameters describing the satellites- planet system were determined. The maximum possible number of different parameters describing the dynamics of Martian satellites was ascertained using all available observational data for the entire time of their observation up to April 1989. The orbital elements of Phobos and Deimos were reliably determined, including the empirical coefficients for the orbital acceleration of the satellites, the coordinates and rate of migration of the Martian pole and areocentric gravitational constant. The coefficient on the second zonal harmonic of expansion of the gravitational potential of Mars was determined quite precisely. The determined value is essentially dependent on whether in the orbital motion of the satellite allowance is made for the eccentricity of its gravity field. The probable values for the coefficients on the third and fourth zonal harmonics of the expansion of the gravitational potential of Mars were determined, but their accuracy is relatively lower. These data made it possible to construct a new, refined model of motion of the Martian satellites. References 23: 11 Russian, 12 Western.

Influence of Light Pressure on Motion of Spacecraft Near Sun

937Q0023C Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 69 No 4, Jul-Aug 92 (manuscript received 8 Apr 91) pp 873-879

[Article by V. V. Koznov, State Astronomical Institute imeni P. K. Shternberg; UDC 521.1]

[Abstract] The photogravitational problem of the motion of a body of finite dimensions was first examined by S. G. Zhuravlev (ASTRON. ZHURN., Vol 66, p 1319, 1989); in that study the radiating body was a material point (a body of spherical structure). This problem is now examined in greater depth. The influence of light pressure on the motion of a spacecraft near the sun is examined. The following model is used as a zero approximation: the sun is a point source of radiation. The influence of light pressure from such a point source can be taken into account in the unperturbed motion of a spacecraft in a central photogravitational field. Formulas are derived for the perturbation function caused by the difference between the radiating sun and a point radiation source. Other formulas are derived for secular perturbations of the elements of an elliptical orbit. The coefficients of secular perturbations are compared for two perturbing factors: the sun's oblateness and the part of the light pressure caused by the finite dimensions of the sun. The calculations show that light pressure exerts the strongest influence on the motion of bodies of a low mass with a large midsection area passing near the sun. For such bodies the secular perturbations of the orbital elements caused by solar radiation pressure are several orders of magnitude greater than the perturbations from the sun's second zonal harmonic. For planets and massive bodies with a small midsection area the influence of light pressure is insignificant. Figure 1; references 11: 9 Russian, 2 Western.

High-Speed Automatic Two-Channel Photometer

937Q0023D Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 69 No 4, Jul-Aug 92 (manuscript received 15 Apr 91) pp 895-900

[Article by B. Ye. Zhilyayev, Ya. O. Romanyuk and O. A. Svyatogorov, Main Astronomical Observatory, Ukrainian Academy of Sciences; UDC 520.2/.8]

[Abstract] A high-speed automatic two-channel photometer was developed for use in precise photometry, as well as in the registry of rapid (about 1 kHz) processes in stars. The photometer was developed, fabricated and tested at the Main Astronomical Observatory, Ukrainian Academy of Sciences, in 1980-1986; in 1987 it was mounted on a 60-cm Zeiss telescope at the Pik Terskol high-mountain observatory in the Elbrus region (elevation 3100 m). The high-speed two-channel photometers at the McDonald and Asiago Observatories were the prototypes of the described instrument. An optical diagram of the suspended unit of this photometer is given with 12 components identified and a block diagram of the data registry system is given. Provision is made for a number of special observation modes: single-photon registry, suppression of multiplicative noise, synchronous photometry. The following are described in detail: data registry system, photometer service modules, photometer time system instruments, photometer technical specifications. Various aspects of the functioning of the instrument are described, such as the algorithm used in control of the data registry system when constructing brightness curves. The capabilities of this photometer are illustrated by observations of the flaring star EV Lac. Figures 3; references: 2 Russian.

Earth-Moon-Halo-Orbit Transfer Trajectories in Vicinity of L_2 of Earth-Sun System

937Q0032A Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 16 Dec 91] pp 435-454

[Article by M. L. Lidov, V. A. Lyakhova, N. M. Teslenko; UDC 629.197.23]

[Abstract] In the context of the Relict-2 project, a problem is examined in which a spacecraft is placed into halo-orbit near the collinear libration point L_2 of the Earth-Sun system. Point L_2 is located roughly 1.5×10^6 km from Earth on the side opposite the Sun. An approximate technique is used to determine the trajectories for the transfer to halo-orbits in a system that was developed by R. W. Farquhar ("Halo-Orbit and Lunar Swing-By Missions of the 1990's," 41st Congress of the IAF, October 1990) and uses the gravitational influence of the Moon. The trajectory runs from Earth to Moon to L_2 vicinity, and its parameters are such that, besides satisfying the condition that $C = 0$, parameters A and B, which determine the size of the orbit, are rather small. The launch profile is such that rendezvous with the Moon does not occur immediately, but only after two revolutions in a severely elliptical orbit with a perigee near Earth and a distance at apogee greater than the radius of the Moon's orbit. On the third revolution, the spacecraft performs a close flyby with the Moon and uses its gravitational pull to continue to L_2. That is particularly important for the Relict-2 project, in which it is assumed that the spacecraft has only a single-axis orientation of engine along the line running from the spacecraft to the Sun. Figures 5, references 4: 3 Russian, 1 Western.

Oscillatory Processes in the Attitude Control of a Viscoelastic Satellite

937Q0032B Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 20 Jan 92] pp 462-472

[Article by Yu. G. Markov, I. S. Minyayev, I. V. Skorobogatykh; UDC 629.7]

[Abstract] A study of oscillatory processes associated with the attitude control of a satellite with elastic elements relative to the center of mass assume that the center-of-mass motions along a given orbit and the motion of the system relative to the center of mass—i.e., rotation of the entire system as well as rotation of the individual elements—are not interrelated. The satellite is a dynamically symmetric mechanical system consisting of elastic and rigid parts. The axis of dynamic symmetry is the axis of symmetry of the elastic part in a nondeformed state, and the boundary layers are axisymmetric. The deformed state of the satellite is described with the linear theory of viscoelasticity. Ignoring the external moments that can usually be discarded in control problems, the researchers in three problems describe the satellite as an oscillatory system without external restorative moments, external damping moments, or a natural position of equilibrium. The only moments acting on the satellite are the controlling moments created by the attitude-control system's controls (e.g., vernier engines). In a fourth problem, the researchers examine the low-level angular oscillations of a gravity-gradient satellite as a whole both outside the plane of orbit of the center of mass and in the plane of orbit. Figures 1, references 6 (Russian).

Control of Motion of Two Bodies Tethered in Gravitational Field by Varying Length of Tether

937Q0032C Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 3 Mar 90] pp 473-482

[Article by A. V. Pirozhenko; UDC 631.3]

[Abstract] Control of the motion of a system of solid bodies in a central force field uses internal forces to keep the kinetic moment of the system unchanged. Which means that such systems can be controlled by merely redistributing the kinetic moment between the relative motion of the system and the motion of its center of mass and by varying the kinetic energy of the system via the internal forces. Traditionally, spacecraft orbit is that context is changed by varying the force of attraction acting on the craft, i.e., producing a change that is resonant with orbital motion and is effected by adjusting the geometry of the spacecraft mass. Based on a model of two concentrated masses joined by an essentially weightless tether, the researchers here study the possibilities presented by a number of configurations for controlling the motion of a system. The configurations are based on the redistribution of the kinetic moment between the orbital motion and the relative motion. Control of orbital motion of a rigid system is effected by maintaining a given attitude in the orbital system of coordinates, whereas control of orbital motion of a system with a flexible tether is effected by varying the length of the tether in modes of both internal and external resonance. The researchers analyze the interrelationship between translational and rotary motions that stems from the constancy of the vector of the kinetic moment of the system. They demonstrate that vectors of the kinetic moments of the translational and orbital motions can be controlled by varying tether length. Averaging is used to construct first-approximation equations for a number of configurations and to estimate the rates of change of the parameters. Figures 3, references 11: 8 Russian, 3 Western.

Optimal Soft Landing of a Spacecraft at a Designated Point on the Moon's Surface From a Circular Artificial Lunar Orbit

937Q0032D Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 4 Dec 91] pp 483-494

[Article by K. G. Grigoryev, Ye. V. Zapletina, M. P. Zapletin; UDC 629.195.3]

[Abstract] Although a number of works in the literature have addressed the problem of producing an optimal soft landing on the Moon for a spacecraft with a high-thrust engine, most have based their work on simplified assumptions that limit the application of the results. The work reported here is an extension of work previously done by the researchers (KOSMICHESKIYE ISSLEDOVANIYE Vol 30, No 2, p 203) in which they used the maximal principle in a polar system of coordinates. The boundary problems were solved by shooting, and the soft landing was examined in a plane of artificial lunar orbit, with the magnitude and direction of thrust controlled. The Moon's field of gravity was assumed to be a central Newtonian field. The landing site was not predetermined, and the researchers studied the effect on optimal trajectory of altitude of initial orbit, thrust capabilities of the spacecraft, specific thrust, and compromise coefficients. Here three types of soft-landing problems are considered numerically: optimal landing in as short a time as possible, optimal landing with minimum mass

expenditure, and optimal landing with minimum magnitude of compromise functional. Figures 8, references 21 (Russian).

Methods and Means of Creating Artificial Formations in Near-Earth Medium and Assessment of Characteristics of Disturbances That Arise. 1. Methods and Means of Creating Artificial Formations

937Q0032E Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 23 Apr 92] pp 495-523

[Article by S. I. Kozlov, N. V. Smirnova; UDC 551.510.536]

[Abstract] Study of near-Earth space with active methods offers a number of advantages, namely, the fact that the parameters of the source of the disturbance are known and that there are virtually unlimited possibilities for choice of altitude and time of experiment, as well as for narrow- and broad-range experimentation. Although the literature contains a wealth of sources on studies of near-Earth space with active methods (with more than 1,000 sources on the effect of radio waves on the ionosphere alone), there are no sources that are of a general nature and that are not limited to some type of artificial disturbance, range of altitudes, location, program, or problem. The researchers here attempt to fill that gap. The paper—a survey—consists of two parts. The first part (presented here) considers, in condensed form, virtually all existing forms of creating artificial formations in near-Earth space, as well as forms under development. The second part (not presented here) assesses the physical characteristics of such formations on the basis of experimental and theoretical work. Among the methods considered are detonation of chemical explosives, plasma-forming injections, plasma-suppressing injections, electrothermal accelerators, electrostatic accelerators, electromagnetic plasma accelerators, magnetoplasma compressors, electron guns, radio waves, and artificial meteors. Figures 10, references 49: 34 Russian, 15 Western.

Analysis of Trajectory and Energy Characteristics of Slow Unusual Waves in the Upper Ionosphere

937Q0032F Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 11 Dec 90] pp 524-533

[Article by D. S. Bratsun, N. A. Zabotin; UDC 533.951.2]

[Abstract] The growth of satellite communications and methods of radio diagnostics of ionosphere and space plasma make slow unusual waves a very interesting target of study. The properties of such waves are extremely important in the analysis of external-probe ionograms, on which the traces of scattered slow unusual waves (or z-modes) serve as an indicator of ionospheric disturbances on small scales. The trajectory features of the slow waves are essential in the magnetospheric propagation in the VLF range. Certain features of the refractive index make slow unusual waves a more complex target of study than other such waves. In light of the fact that the question of a more general three-dimensional shape of the trajectories of slow unusual waves and their attenuation is virtually untouched in the literature, the researchers here chose to examine that very question. Section 1 of the paper involves an analytical study of the resonance properties of the refractive index and of the features of the asymptotic behavior of wave packets. Section 2 presents the results of a numerical study of trajectory and energy characteristics of slow unusual waves in the plane of the magnetic meridian. Section 3 demonstrates how the beam approach can be used to track the shape of trajectories near a special point of the refractive index in the plane of the magnetic meridian. Section 4 is devoted to a numerical study of the trajectory and energy characteristics for three dimensions. Section 5 provides a brief discussion of the possible applications of the results of the study, among them the analysis of results of external probing of the ionosphere from aboard satellites and the study of nonlinear effects in the propagation of electromagnetic waves in the ionosphere. Figures 3, references 9: 6 Russian, 3 Western.

Measurement of Large-Scale Plasma Blobs in Polar Latitudes From AUREOL-3 Satellite

937Q0032G Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 13 Nov 91] pp 534-542

[Article by A. Ye. Stepanov, Yu. I. Galperin, K. Begen, A. A. Serov; UDC 551.537]

[Abstract] The first descriptions of plasma blobs were published almost 20 years ago on the basis of measurements of incoherent scattering made at Chatanika. They were quickly discovered to be not only in the nightside auroral region, but also at the northern and southern polar caps and the dayside polar cusp. The mechanism of their formation, however, has never been fully explained. This paper reports calculations of drift trajectories made on a stationary electrical-field model for large-scale plasma blobs selected from approximately 1,000 passes made by the AUREOL-3 satellite at polar latitudes in the context of the ARCAD-3 project. A comparison of the calculations and simultaneous IMF data shows that the blobs form in the region of the dayside polar cusp or near it when there are dramatic variations in IMF components. The researchers suggest that blobs can form as a result of nonadiabatic compression of ionospheric plasma at the interface between converging plasma drift velocities (within the cusp the convection is new, outside it old) that result from nonstationary, turbulent convection structure. With a boundary width of less than or equal to 100 km, the Reynolds number is less than unity. As a result, one can expect the plasma turbulence and the magnetic field diffusion to produce nonadiabatic processes disturbing the freezing-in of plasma and its compression. Figures 1, 26 references: 6 Russian, 20 Western.

Turbulence in Inhomogenous Ionospheric Plasma and Charged-Particle Fluxes From Kosmos-900 Data

937Q0032H Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 12 Mar 91] pp 543-546

[Article by N. I. Izhovkina, N. M. Shyutte; UDC 533.951]

[Abstract] Earlier, the data of charged-particle-flux measurements made by Kosmos-900 revealed that in the internal magnetosphere where L is less than or approximately equal

to 2, there are at the tail of the function of the energy distribution of particles sporadic bursts whose intensities can be as high as approximately second-order magnitude. For particles with energies of less than 300 eV, it has been found that the maximum intensities of electron and ion fluxes appear in antiphase. Bursts are observed more often in daytime than in nighttime. The relative frequency of observations of bursts in the vicinity of the South Atlantic Magnetic Anomaly has been as high as 90 percent. But no clear-cut relationship has been identified between frequency of observations and geomagnetic field K_p index, nor has any relationship been ascertained with the D_{st} index. This paper presents the results of analytical calculations of the build-up of electrostatic turbulence in inhomogenous plasma. The results make it possible to link the sporadic nature of the appearance of the bursts and the observation of maxima in electron and ion fluxes for energies of less than 300 eV in antiphase with the development of low-frequency electrostatic turbulence in the inhomogenous plasma of the upper ionosphere. Figures 1, references 7: 6 Russian, 1 Western.

Optimization of the Angular Distance Between Two Artificial Earth Satellites in Circular Orbit With Positions Pinpointed From Mutual Astronomical Measurements

937Q00321 Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30, No 4, Jul-Aug 92 [manuscript submitted 25 Apr 91] pp 563-565

[Article by V. V. Smirnov, A. D. Golyakov; UDC 629.78]

[Abstract] Researchers use astronomical measurements to determine the angular distance between two artificial Earth satellites in circular orbit. The parameters of one satellites are pinpointed from observations of the other satellite against the backdrop of the stellar sky, i.e., from mutual astronomical measurements. The relative position of the two satellites is described as the angle u between their radii-vectors, which is optimized with the criterion of the minimum of the sum of dispersions of coordinate errors. The optimal angular distance is found to be approximately $\pi/6$. Figures 1, references 1 (Russian).

Astroclimate of Alpine Astrostations in Central Asia Relative to Highly Precise Radiotelescopes

927Q0240A Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENISTANA: SERIYA FIZIKO-MATEMATICHESKIKH, TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 3, May-Jun 92 pp 11-21

[Article by M. B. Berkeliyev and Yu. V. Khan, Physical Technical Institute, Turkmen Academy of Sciences; Solntse Scientific Production Association, Turkmen Academy of Sciences; UDC 522.525.72+535+551.51+520.272.2

[Abstract] With respect to the amount of clear time and atmospheric transparency conditions alpine astrostations in Central Asia come close to the best astronomical observatories in the world. The degree of atmospheric transparency at alpine astrostations in Central Asia to elevations 2.5-3 km is determined primarily by aerosol extinction in both the visible and IR spectral regions. Aerosol extinction in the IR spectral region is considerably greater than molecular extinction. Aerosol extinction is greater in summer than in winter; this is attributable to atmospheric dust content. The absorption of IR radiation is determined to a considerable degree by atmospheric moisture content. After precipitation atmospheric transparency in summer is sharply increased. The perturbing influence of the free atmosphere (about 3000 m to 16 000-20 000 m) on the quality of the astronomical image considerably exceeds the corresponding influence of the atmospheric surface layer, which indicates an important role of aerosol particles in the formation of turbulence optical factors. The morning hours after sunrise and the evening hours before sunset, within the limits of a single hour, are most favorable for observing the sun with an optical telescope and in most cases the use of a radio telescope, which is ensured by the corresponding conditions for transition from a nighttime inversion with negative vertical temperature gradients to daytime convection and vice versa. Figures 3; references 21: 17 Russian, 4 Western.

Polynomial Representation of Artificial Earth Satellite Numerical Ephemerides

937Q0046 Kiev KINEMATIKA I FIZIKA NEBESNYKH TEL in Russian Vol 8 No 5, Sep-Oct 92 [manuscript submitted 10 Jan 92] pp 72-81

[Article by K. A. Taybatorov, A. A. Trubitsina, Institute of Theoretical Astronomy, Russian Academy of Sciences, St. Petersburg; UDC 521.98]

[Abstract] Basic and applied work in astronomy, geophysics, geodesy, and navigation involves the use of ephemeris data, which are computed on the basis of analytical and numerical theories of motion of celestial bodies. The ephemerides of certain types of artificial Earth satellites—geodesy and navigation satellites—are of particular interest, and the requirements for accuracy are becoming increasingly more stringent. That underlies the need for the development of increasingly more precise models of dynamic systems and algorithms for computing ephemerides. The ephemeris data must also be compact and simple to use in today's computers. That prompted the researchers here to apply an earlier-developed technique of polynomial approximation of ephemeris data—one that makes use of Chebyshev expansions—to construct the numerical ephemerides of artificial Earth satellites. The technique is performed simultaneously with INCH numerical integration within the same program, which involves less computation time and computer memory (RAM and ROM) than does the commonly used numerical integration and polynomial representation techniques. Figures 2, references 17: 9 Russian, 8 Western.

Photometry and Colorimetry of Asteroids With Digital TV Complex

937Q0047 Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26 No 5, Sep-Oct 92 [manuscript submitted 30 Jan 92; resubmitted 1 June 92] pp 3-13

[Article by V. V. Prokofyeva, M. I. Demchik, L. G. Karachkina, Ye. P. Pavlenko; Crimean Astrophysical Observatory, Uzhgorod State University, Institute of Theoretical Astronomy, Russian Academy of Sciences; UDC 523.44+520.374]

[Abstract] With the number of asteroids with identified orbits as of the end of 1991 at 5,000, planetary cosmogony and the space program are in sore need of studies of their physical characteristics, as is the area of science that studies the asteroids that present the most danger in terms of collisions with Earth. The current level of development of techniques of astrophysical research has made it possible to ascertain the characteristics of certain of the small planets, but the specifics of observations of bodies moving against the backdrop of the stellar field require special techniques. The researchers here developed and tested a technique involving digital TV photometry and colorimetry of asteroids. The accuracy of the photometry performed on a 0.5-meter meniscus telescope (Maksutov system) in spectral bands B, V, and R is +/-0^m.02 for bright objects with a light curve of up to 13^m and +/-0^m.05 for 16^m objects when exposition time is 100 sec. Penetrating power is 2^m lower for simultaneous observations of B, V, and R. The researchers detail their observations of 1727 Mette, 87 Sylvia, and 423 Diotima, and they conclude that both differential and absolute photometry should be used in observing asteroids. Figures 5, references 21: 15 Russian, 6 Western.

Statistical Analysis of Energy Spectra of Cosmic Gamma Bursts Detected in Apex Experiment

937Q0048 Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 69 No 5, Sep-Oct 92 [manuscript submitted 3 Sep 91] pp 1052-1061

[Article by I. G. Mitrofanov, A. A. Kozlenkov, V. Sh. Dolidze, A. S. Pozanenko, D. A. Ushakov, A. M. Chernenko, J.-L. Atteia, C. Barat, G. Vedrenne, E. Jourdain, M. Niel, Space Research Institute, Russian Academy of Sciences; Center for the Study of Cosmic Radiation, Toulouse, France; UDC 524.1]

[Abstract] The Soviet-French APEX Experiment detected about 60 cosmic gamma bursts over the eight months that Fobos-2 was operational. The immense amount of data associated with those events was extremely varied, with the intensities of the bursts ranging from 10^{-3} erg/cm^{2}s to 10^{-5} and the durations ranging from tens of milliseconds to tens of seconds. Considerable differences were noted not only for the individual events, but also for the individual bursts. That prompted the researchers to use a statistical approach in attempting to ferret out general patterns linking spectral shapes with, for example, burst position, radiation-flux magnitude, and burst intensity. But the study differs from a statistical analysis of gamma bursts as such in that the only target of study is the spectrum measured in a given interval. The researchers managed to show that intense bursts generally have harder spectra and that the evolution of intense and weak bursts along their time profiles is also different in that the intense bursts generally have harder fronts. Solitary neutron stars, the researchers note, appear to the be sources of gamma bursts, but the source of the gamma bursts is still undetermined. References 24: 3 Russian, 21 Western.

Radio Interferometry Observations With Eastern Hemisphere Antennas

937Q0049 Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 18 No 10, Oct 92 [manuscript submitted 2 Jun 92] pp 891-900

[Article by L. I. Matveyenko, G. D. Kopelyanskiy, A. V. Shevchenko, D. A. Graham, W. A. Sherwood, Yu. N. Gorshenkov, S. P. Ignatov, N. S. Nesterov, R. L. Sorochenko, Space Research Institute, Russian Academy of Sciences, Moscow; Institute of Radioastronomy imeni M. Planck, FRG; Special Design Bureau of the Moscow Power-Engineering Institute; Scientific Research Institute of Space-Related Instrument-Making, Moscow; Crimean Astrophysical Observatory, Nauchnyy; Physics Institute, Russian Academy of Sciences, Moscow; UDC 520.274]

[Abstract] Very-long-baseline interferometry (VLBI) has become a powerful means of studying fine structures of astronomical objects, measuring the coordinates of spacecraft, and solving a number of applied problems. The capabilities of the technique are a function of the sensitivity of the interferometers, which is determined by the sensitivity of the radiotelescopes they consist of—i.e., the effective area of the antennas, the noise temperature, the signal-detection band, and the coherent accumulation time. The researchers here present the preliminary results of radioastronomy studies performed with a VLBI system consisting of radiotelescopes located in the Eastern hemisphere (Ussuriysk, Medvezhi Ozera, Simenz, Yevpatoriya, Pushchino, Medicina, Effelsberg, Onsala, Shanghai, and Kashima). The studies involved astronomical objects that were examined in 1990-1991 at a wavelength of 18 cm with left circular polarization. Angular resolution was 5 arc msec. The variability in the sensitivity of the interferometers that were used enabled investigation of the structure of maser sources. The principal components of source W51 were found to be concentrated in an area not exceeding 50 msec of arc and has LSR velocities of 58.0-59.5 km/sec, flux densities of 40-80 Jy, and spectral lines widths of 0.37-0.50 km/sec. The different sensitivities of the interferometers used in the study made it possible to study the structure of objects with $F \geq 100$ mJy. Maximum angular resolution was 5 msec of arc. Figures 4, references 6 (Russian).

Nonlinear Resonances During Uncontrolled Atmospheric Descent of Asymmetric Spacecraft

937Q0050A Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30 No 5, Sep-Oct 92 [manuscript submitted 13 Mar 91] pp 608-614

[Article by V. S. Aslanov; UDC 533.6]

[Abstract] Spacecraft that are designed for uncontrolled atmospheric descent are, as a rule, axisymmetric. However, factors like design features and imprecise manufacture result in a small amount of dynamic and aerodynamic asymmetry. The rotation of an asymmetric spacecraft in the atmosphere is nonstationary and dual-frequency, and resonances have a considerable influence on the motion. In an earlier work, the researcher presented results of a study of spacecraft motion in a near-resonance region that assumed that the spacecraft's rotation was uniform. This paper adds to those results and extrapolates to a general case for the motion of an asymmetric spacecraft near the center of mass during atmospheric descent. The motion of the spacecraft is divided into fast and slow, and two fast variables are singled out—the phase of the spatial angle of attack and the angle of proper rotation. For the general case, a system is proposed

for reducing the equations of motion to a standard two-frequency system. The researchers establish the general conditions of resonance in which the linear integer combination of oscillation frequency of angle of attack and average frequency of proper rotation is close to zero. New forms of nonlinear resonance are identified. References 4 (Russian).

Three-Dimensional Shapes of Bodies With Minimal Surface Heating During Hypersonic Motion in Atmosphere

937Q0050B Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30 No 5, Sep-Oct 92 [manuscript submitted 26 Jul 91] pp 615-628

[Article by M. A. Arguchintseva, N. N. Pilyugin; UDC 535.23:531]

[Abstract] An intensive study of the planets of the solar system entails solving a number of problems that can only be studied with vehicles that descend to a planet's surface along a ballistic trajectory. At the hypersonic speeds associated with entry into an atmosphere, space vehicles undergo intense convective and radiation heatup. One effective means of reducing the level of heating is to choose vehicle shapes that ensure the smallest amount of heating of the vehicle's surface along the descent trajectory. Recent years have seen a search for new three-dimensional shapes that provide optimal thermophysical and aerodynamic characteristics. The researchers here study a problem involving optimization of shape with minimum total surface thermal flux (convective and radiation) along a trajectory in the Earth's atmosphere. They find that optimal shape produces a total flux of 25-33 percent, wave drag of 9-18 percent, and friction resistance of 11-20 percent. Figures 5, references 15: 14 Russian, 1 Western

Methods and Means of Creating Artificial Formations in Near-Earth Medium and Assessment of Characteristics of Resulting Disturbances 2. Assessment of Characteristics of Artificial Disturbances

937Q0050C Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30 No 5, Sep-Oct 92 [manuscript submitted 24 Jul 92] pp 629-683

[Article by S. I. Kozlov, N. V. Smirnova; UDC 551.510.536]

[Abstract] Part 1 of this paper considered, in condensed form, virtually all existing means of creating of artificial formations in near-Earth space, as well as means under development. Part 2 assesses the physical characteristics of such formations on the basis of experimental and theoretical work. Briefly, the means used to create the formations were detonation of chemical explosives, plasma-forming injections, plasma-suppressing injections, electrothermal accelerators, electrostatic accelerators, electromagnetic plasma accelerators, magnetoplasma compressors, electron guns, radio waves, and artificial meteors. The assessment of the formations took into consideration electron density, ion composition, charged-particle flux, air temperature and density, neutral composition, airglow (in the UV, IR, and visible ranges), electric and magnetic fields, and stimulated emissions of the disturbed media in a rather broad range of frequencies. The researchers conclude that in the future, active experiments in near-Earth space will be widely used to solve an array of scientific, applied, and environmental problems, as the CRRES program is currently doing. Variations in the parameters measured are largely interdependent and are a function of the means used to create the disturbance, the altitude, the geomagnetic latitude, and the heliogeophysical conditions. Figures 13, references 141: 61 Russian, 80 Western.

Wind in the Northern Polar Atmosphere of Venus

937Q0050D Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30 No 5, Sep-Oct 92 [manuscript submitted 20 Mar 91] pp 695-699

[Article by I. R. Vaganov, O. I. Yakovlev, S. S. Matyugov, V. N. Gubenko; UDC 543.72:523.42]

[Abstract] This paper is a continuation of an earlier paper ("Zonal Winds in the Southern Polar Regions of Venus From Radio Occultation Data," KOSMICHESKIYE ISSLEDOVANIYA, 1992, Vol 30, No 3) that presented the results of a determination of the velocity of zonal circulation in the polar and near-polar atmosphere of the southern Venusian hemisphere. Here, the researchers present similar data that was gathered by Venera-15 and -16 and is associated with the velocity of zonal wind in the polar and near-polar atmosphere of the northern hemisphere at altitudes of 50-80 km. Temperature and pressure data gathered through radio occultation performed in 27 regions at latitudes of greater than 60° were used in the assessment. Zonal wind velocity is determined in approximation of the cyclostrophic balance, and tie-in of the results to altitude was done under the assumption of an average planetary radius of 6,051 km. At high latitudes, it was found, there is a jet stream with a virtually invariable axis that travels at an altitude of approximately 60 km; the latitude of the axis varies within the range of 70-75°, staying mostly at 73-75°. Wind speed along that axis reaches 100 m/s^{-1}. Zonal circulation is completely suppressed at 75 km altitude in the near-polar latitudes and at lower altitudes in the polar latitudes. Comparison of the northern and southern hemispheres indicates a symmetry of zonal circulation relative to the equatorial plane at altitudes of below 59 km. Above that altitude, in the near-polar latitudes, there are jet streams with roughly identical positioning of axes in terms of altitude and latitude. Maximum wind velocities in the streams differ by no more than 10 percent. The symmetry dissolves above 63 km. Figures 5, references 7: 6 Russian, 1 Western.

Study of the Radiation Conditions Aboard the Mir Station During the 29 September 1989 Solar Proton Event Based on Data of the Lyulin Dosimeter-Radiometer

937Q0050E Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 30 No 5, Sep-Oct 92 [manuscript submitted 13 Jun 91] pp 700-708

[Article by V. V. Bengin, T. A. Kostereva, V. S. Makhmutov, N. A. Panova, V. M. Petrov, V. A. Shurshakov, Ts. P. Dachev, I. V. Semkova, Yu. N. Matviychuk, N. G. Bankov, Institute of Biomedical Problems, USSR Ministry

of Health; Laboratory of Solar-Terrestrial Interactions, Bulgarian Academy of Sciences; UDC 612.014]

[Abstract] The Lyulin dosimeter-radiometer was used to measure dose rate and charged-particle flux aboard the Mir station during September and October 1989. Data are reported for 29 September 1989, the date of a solar proton event. The station's orbital parameters for the two months were as follows: apogee 410 km, perigee 379 km, orbital inclination 51.6°. The Lyulin consists of two units: a detector and a display unit. The detector is miniature dosimeter-radiometer that consists of a silicon surface-barrier detector, a preamp, a voltage-to-frequency converter, four batteries, and an 8-digit display. The display unit contains a modular microcomputer that collects data on dose rate and particle flux in two 4KB online memories, processes the data and displays them, inputs controlling parameters into the buffer memory, feeds the information to the station's telemetry system and onboard computer, and converts the onboard voltage to a working voltage for the entire system. Additional absorbed dose during the event was found to be 0.31 cGy, and the average diurnal dose rate exceeded background levels by 10-fold. The temporal variations in dose rate inside the station are in agreement with the dynamics of solar proton fluxes in near-Earth space that were identified in the data of the GOES-7 satellite. Figures 5, references 21: 16 Russian, 5 Western.

Regionalization of Lunar Disk Based on Albedo, Color Index and Degree of Polarization. First Quarter

937Q0022A Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26 No 3, May-Jun 92 (manuscript received 24 Jun 91, after revision 28 Jan 92) pp 14-25

[Article by O. I. Kvaratskheliya, V. V. Novikov and Kh. G. Tadzhidinov, State Astronomical Institute imeni P. K. Shternberg; UDC 523.34.82]

[Abstract] The results of digital processing of telescopic images of the moon obtained using polarization and false-color filters were used in defining optically typical regions on the lunar surface and a study was made of the representativeness of seven spacecraft landing sites with respect to the optical characteristics of the eastern part of the lunar disk. The initial observational material was photographs of the eastern part of the lunar disk obtained on 15 February 1989 using a Zeiss-600 telescope with a glass light filter and polaroid at an effective wavelength 450 nm, as well as a photograph in the red region at 650 nm. Whereas according to the albedo-color or albedo-degree of polarization dependence the landing sites correspond to about 40 percent of the studied area, regionalization on the basis of all three optical parameters reveals a representativeness of these sectors for 15 percent of the studied area. A method was developed for areal visualization which makes it possible to judge where on the surface it is most probable that lunar rocks may be encountered which are present in terrestrial collections. The possibility of mineralogical mapping of the lunar surface on the basis of the interrelationship between the optical and chemical properties of lunar regolith is discussed. Figures 3; references 17: 14 Russian, 3 Western.

Gravitational Spreading Structures in Maxwell Mountains Rock Complex on Venus

937Q0022B Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26 No 3, May-Jun 92 (manuscript received 6 Feb 92, after revision 21 Feb 92) pp 26-43

[Article by A. A. Pronin and M. A. Kreslavskiy, Geochemistry and Analytic Chemistry Institute imeni V. I. Vernadskiy; UDC 523.42]

[Abstract] An analysis of radar images and altimetry obtained by the Venera 15, Venera 16 and Magellan spacecraft is presented. An attempt is made to interpret the structures of the Maxwell Mountains on Venus using radar images. It is shown that their interpretation on the basis of geological experience makes it possible to discriminate on the surface mass a regular change of zones of dilatation and compression whose position correlates with their elevational position. This suggests an influence of gravitational potential on the distribution of such zones, which gives basis for applying a numerical model within whose framework the behavior of the rock mass is described by the motion of a very viscous incompressible fluid in a gravity field. A comparison of the results of an analysis of morphology and modeling gives a satisfactory agreement, indicating applicability of such an approach. Since a medium consisting of two layers, which theoretically can correspond to the crust and mantle, is examined in the model, and real surface relief is used, this makes it possible to estimate the thickness of the upper (crustal) layer for the investigated rock mass. The estimate gives a thickness of this layer 50-60 km, which approximately corresponds to estimates of crustal thickness for the mountainous regions of Venus. Figures 16; references 13: 5 Russian, 8 Western.

Discriminating Optically Typical Sectors on Lunar Disk Using Albedo and Degree of Polarization

937Q0022C Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26 No 3, May-Jun 92 (manuscript received 25 Jan 91, after revision 17 Oct 91) pp 99-110

[Article by O. I. Kvaratskheliya, V. V. Novikov and Kh. G. Tadzhidinov, State Astronomical Institute imeni P. K. Shternberg; Space Data Scientific Research Center; Abastumani Astrophysical Observatory; UDC 523.34-8]

[Abstract] The basic premise of this research was that the primary factor exerting an influence on the formation of reflected moonlight is the geochemical composition and mineralogical inhomogeneities of lunar regolith. Two possibilities for two-parameter regionalization of the lunar surface are examined on the basis of the albedo-degree of polarization dependence: using the results of cluster analysis of two-dimensional scaytograms and using test regions (landing sites). Digital processing of polarized telescopic images obtained at an effective wavelength 450 nm was carried out. Suitable programs and algorithms were written for this purpose. A study was made of the spatial distribution of optically typical regions on the lunar disk. Seven regions of lunar landing with a mean area of about 800 km^2 are characteristic for about 40 percent of the surface of the eastern part of the lunar disk. The representativeness of landing sites in the western part was less. A simplified model is proposed for a geochemical interpretation of lunar optical parameters. This model has proven correct only for waterless lunar rocks with a low content of volatiles. Figures 6; references 16: 12 Russian, 4 Western.

Photoelectric Observations of Mars During 1990 Opposition Period

937Q0024A Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26 No 4, Jul-Aug 92 (manuscript received 5 Dec 91, after revision 13 Mar 92) pp 3-11

[Article by V. D. Vdovichenko, S. M. Gaysin and S. A. Mosina, Astrophysics Institute imeni V. G. Fesenkov, Kazakh Academy of Sciences; UDC 523.4]

[Abstract] The results of research on the spectral reflectance of the Martian central meridian are given. The observations were made using a 70-cm reflector with an automated astrophysical planetary spectrophotometric apparatus. The Martian atmosphere exhibited no global changes during the period of observations at the opposition of 1990. Its state was relatively calm and was not subjected to the influence of large-scale dust storms which possibly preceded the described observations, evidence for which is the weak contrast of the north polar cap in blue light and its complete

disappearance in the visible range. Research on the absolute spectral and photometric properties of the Martian surface in the range of phase angles greater than 30° merits increased attention. The spectral reflectance characteristics of the surface for individual Martian longitudes indicate the possibility of the existence of a sulfate absorption band at 350-380 nm and also narrow absorption bands at 800-1100 nm with small variations of intensity and the positions of their centers, not characteristic for broader mineralogical absorption bands containing ions of transition metals. Confirmation of the findings in this study could serve as a basis for developing a comparative mineralogy method and a new instrument for an orbital spacecraft for the purpose of plotting maps of the distribution of sulfates on the Martian surface from the ratio of photometric profiles of the planet registered at 350-380 nm (or 750-1100 nm). Figures 5; references 17: 7 Russian, 10 Western.

Models of Mars and Phase Transitions in Its Mantle

937Q0024B Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26 No 4, Jul-Aug 92 (manuscript received 27 Feb 91) pp 12-18

[Article by Ye. I. Severova, Earth Physics Institute, Russian Academy of Sciences; UDC 523.43]

[Abstract] Models of Mars with different variants of composition of the mantle and core (the crust is not taken into account, two-layer models are considered) are constructed using the equations of state proposed by different authors. Among the models considered are those published by Ringwood, Dreibus, Binder and Davis and three new models also are proposed. It is assumed that Mars and the Earth have similar compositions and that the figure of Mars is close to hydrostatic equilibrium. In the different models the radius of the core differs up to 10 percent and the moment of inertia falls in the range 0.361-0.371. With an increase in core mass the pressure at the core-mantle interface decreases. Diagrams are constructed for representing the dependence of the relative radius of the core on its relative mass and density distribution in the Martian mantle. Since it is postulated that two important phase transitions exist in the Earth's mantle, the Martian mantle, assuming that it is chemically homogeneous and consists of similar matter, also may have these phase transitions. It also is postulated that the olivine-spinel transition in all models may occur at a depth 927-1100 km. The pressure necessary for the postulated spinel-postspinel transition in all models but one is attained at depths 1800- 2200 km, near the mantle-core interface. Figures 4; references 16: 3 Russian, 13 Western.

Optical Characteristics of Landing Sites of Nonreturnable Spacecraft on Eastern Part of Lunar Disk

937Q0024C Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 26 No 4, Jul-Aug 92 (manuscript received 4 Feb 92, after revision 26 Mar 92) pp 39-50

[Article by V. V. Novikov and Kh. G. Tadzhidinov, State Astronomical Institute imeni P. K. Shternberg; UDC 523.34.82]

[Abstract] Two- and three-parameter regionalization of the lunar surface was carried out using data for the landing sites of the spacecraft Ranger 6, Ranger 8, Surveyor 5 and Lunokhod 2. These regionalizations are based on albedo, color and degree of polarization data. The problem was solved using observational photomaterial for the first quarter of the moon obtained in February 1989 using a Zeiss 600 telescope with glass light filters and a polaroid with observations at an effective wavelength 450 nm. The three mentioned optical parameters are used in evaluating the representativeness of the lunar landing regions in mare sectors. Two methods are proposed for visualization of optically typical regions on the lunar disk: point and areal. The merits and shortcomings of these two methods are discussed. Then these two methods are integrated and the results are illustrated. The presented materials give a clearer picture of the degree of study of the eastern part of the lunar disk by direct methods. The results indicate where on the lunar surface it is possible to encounter sectors optically similar to the mentioned spacecraft landing sites and for which the physicochemical characteristics of the regolith are known. It is concluded that three-parameter regionalization on the basis of reflected light characteristics can serve as a basis for lunar mineralogical mapping. Such studies also will be useful when selecting landing sites for future lunar probes. Figures 4; references 12: 10 Russian, 2 Western.

Details of 'Polyus' Spacecraft Flown on First Energiya Launch

937Q0064 Moscow ZEMLYA I VSELENNAYA in Russian No 4, Jul-Aug 92 pp 18-23

[Article by Yu. P. Kornilov, chief lead designer at KB Salyut, under the rubric "Space Program": "The Little-Known Polyus"; first paragraph is source introduction]

[Text] **December 1991 saw in IZVESTIYA the first-ever mention of the Skif-DM spacecraft, which was created as the payload for the Energiya launch vehicle. The chief lead designer of KB Salyut tells us about the development of what was the largest space vehicle in history.**

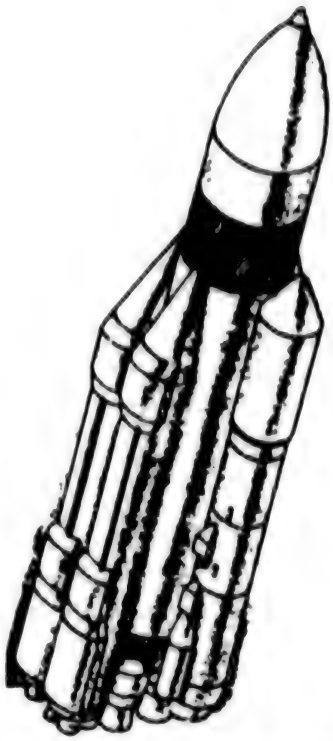
Polyus. Just What Was It?

The name Skif-DM, along with a numeral assigned by the regulations in effect then, was given to the vehicle for formal use in all documents. In the TASS report prepared for the 15 May 1987 launch, the vehicles was officially called Polyus. And that was the name printed on the side of the vehicle. But on 16 May 1987, only the following could be found in all the Soviet newspapers: "In the Soviet Union, flight-design tests have gotten under way for the new, heavy-lift, all-purpose launcher, Energiya, which is designed for placing reusable orbital spacecraft and large space vehicles with science and economic missions into near-Earth orbit. The two-stage all-purpose launcher...is capable of placing a payload of more than 100 tons into orbit. On 15 May 1987, at 2130 hours Moscow time, the first launch of that rocket took place at Baykonur....

"The second stage of the launcher...sent a full-scale mockup of a satellite to a designated point. The full-scale mockup, after separation from the second stage, was to use its own engine to enter a circular near-Earth orbit. However, because of its onboard systems did not work properly, the mockup did not enter the assigned orbit and splashed down in the Pacific Ocean...."

Thus ended almost two years' of intense work by dozens of enterprises from many departments under the guidance of the Ministry of General Machine Building and the head developer of the mockup, KB Salyut. Just what kind of a "mockup" was that, a mockup whose creation involved considerable efforts on the part of our space sector?

We had long become accustomed to the fact that TASS reports involving the space program had to be read between the lines. And in that case, careful readers, even those at great remove from the space program, probably noted some strange things in the report. Besides that, all the photos of the Energiya rocket at launch that appeared in the press were taken from the same spot, so that the payload wouldn't be visible. All that suggested that the payload was not just a mockup. Why did the full-scale mockup have to be equipped with "its own engine" for orbital injection, and why did it have to have its own "onboard systems," even if they turned out not to work properly? And another thing was clear: to enter orbit independently requires a "brain" that controls the operation of that engine and all the other systems, i.e., this was an honest-to-goodness space vehicle we were talking about.



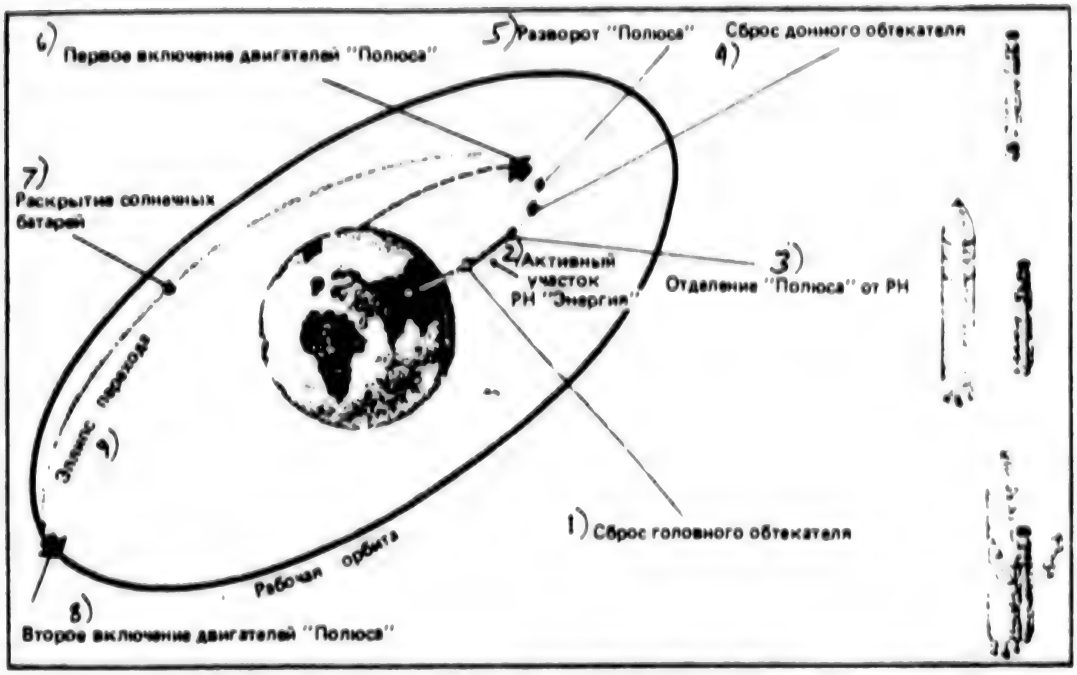
Artist's conception of launch of Polyus space vehicle on the Energiya launch vehicle

And that's just what it was, essentially. But the Polyus space vehicle was conceived in July 1985 as, in fact, a mockup with which the first launch of Energiya, planned for the autumn of 1986, would take place. That came about after it became clear that the primary payload of the rocket—the Buran orbital craft—would not be ready in time. At first, the job didn't seem all that complex—after all, making a 100-ton "dummy" wouldn't be hard. But suddenly, KB Salyut received a request-order from the minister of general machine building: convert the "dummy" into a space vehicle for performing geophysical experiments in near-Earth space and thereby combine the tests of Energiya and the 100-ton vehicle. The idea, of course, made sense, but, unfortunately, that left less than a year to create the vehicle.

'Don't Worry About How Much Money It Takes!....'

The way we did things in our space sector, a new space vehicle usually took at least five years to develop, test, and build. But now we had to find a completely new approach. It was decided that we would use, as much as possible, sections already built and instruments, equipment, already-tested mechanisms and assemblies, and plans from other "articles" (that's what the military and the space industry traditionally call a final manufactured product).

The Khrunichev Machine Building Plant, which was assigned to assemble Polyus, began immediately to prepare for production. But those efforts would clearly not have been enough, had they not been energetically supported by



Profile of injection of Polyus space vehicle into near-Earth orbit.

1. Jettison of nose fairing—2. Powered segment of Energiya launch-vehicle flight—3. Separation of Polyus from launch vehicle—4. Jettison of bottom fairing—5. Turn of Polyus—6. First cut-in of Polyus engines—7. Opening of solar arrays—8. Second cut-in of Polyus engines—9. Transfer ellipse—10. Working orbit

the leadership—every Thursday, there were operations meetings at the plant that were led by Minister O. D. Baklanov or his deputy O. N. Shishkin. At those meetings, pressure was put on manufacturing-enterprise managers who were inefficient or who disagreed about something, and whatever help might be needed was discussed.

As a rule, no excuses were accepted—not even the fact that it was almost the same group of people who, at that same time, were performing the grandiose work associated with the creation of Buran. Everything took a back seat to meeting the deadlines assigned from the top—a clear example of the administrative- command techniques of leadership: "arbitrary" idea, "arbitrary" execution of the idea, "arbitrary" deadlines, and "Don't worry about how much money it takes!"

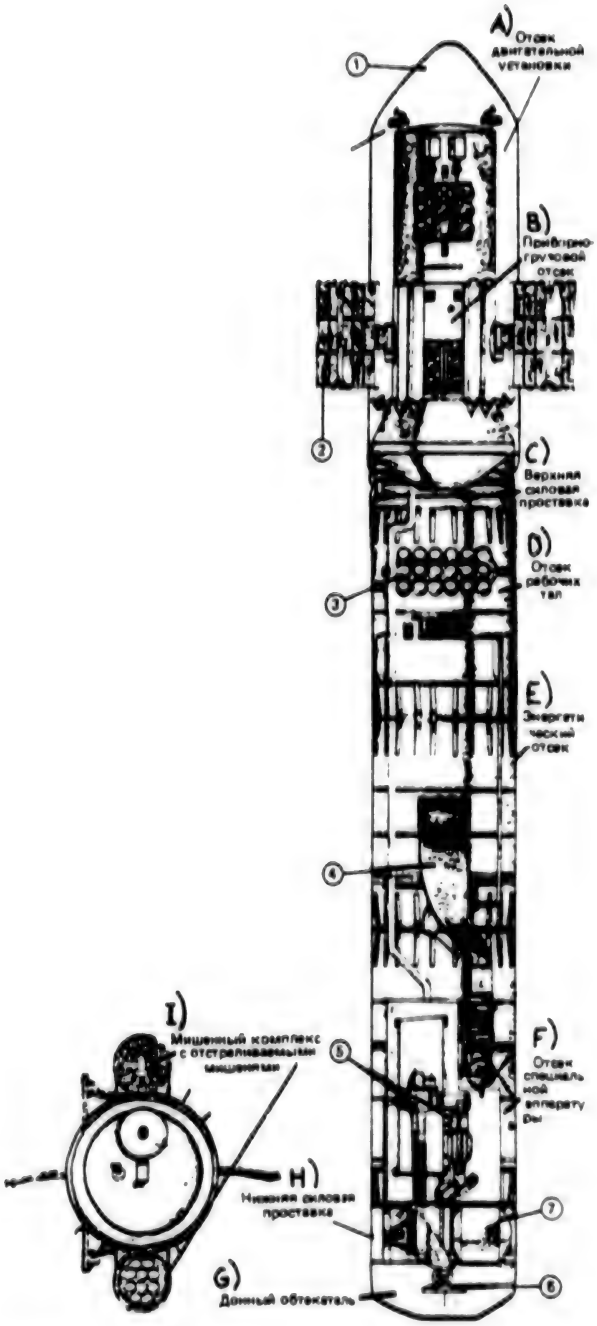
In July 1986, all the sections, including those that had been redesigned and remanufactured, were already at Baykonur.

Polyus Configuration

The "article"—almost 37 m long in all, with a diameter of 4.1 m and a weight of about 80 tons—consisted of two main sections: the smaller one serving as an operations/service unit, and the other (larger) serving as a special-purpose module. The operations/service unit was a 20-ton craft that had long been perfected by KB Salyut and had only minor modifications for the new mission: it was almost the same as the Kosmos-929, -1267, -1443, and -1668 cargo resupply craft and the Mir station modules. It housed the systems for control of motion and control of the onboard complex, the telemetry-control system, the command radio link system, the temperature-control system, the power supply system, the system for separating and jettisoning the fairing, antenna gear, and a system for controlling science experiments. All the instruments and systems that could not hold up in a vacuum were located in a sealed instrument-payload section. The propulsion section housed four sustainer engines, 20 attitude-control engines, 16 vernier engines, tanks, and pipes and valves of the pneumohydraulic system serving the engines. On the sides of the propulsion section were solar arrays that opened after orbital injection.

A great deal of work was done by the KB to create a large new nose fairing for protecting the operations/service unit from the onrushing air stream. For the first time ever, it was made of nonmetallic material—carbon-filled plastic.

The special-purpose module was redesigned and remanufactured. The designers depended on maximum use of already perfected assemblies and technologies. For example, the diameter and structure of all the sections made it possible to use the production equipment that was available at the Khrunichev Plant. The assemblies that connected the launcher and the spacecraft were already manufactured—they were the same assemblies used for Buran, such as the transfer and docking unit that linked Polyus with the ground on the pad. The system for separating Polyus from the rocket was also the same as for Buran.



Configuration of Polyus space vehicle: 1. Nose fairing—2. Solar arrays—3. Working-medium storage and feed system—4. Momentless exhaust system ("trousers")—5. Future space vehicle approach and docking system—6. onboard-radar antenna—7. targets

A. Propulsion section—B. Instrument-payload section—C. Upper structural adapter—D. Working-medium section—E. Power- engineering section—F. Special-gear section—G. Bottom fairing—H. Lower structural adapter—I. Target complex with fireable targets

Since the operations/service unit was, essentially, a spacecraft that had already been developed, the loads it had been designed to take during a liftoff of the Proton launch vehicle had to be kept to. For that reason, of all the configuration versions, the only one that could be chosen was one in which the operations/service unit would be located in the nose of Polyus. And since it would be disadvantageous to move the propulsion system (which had been placed in the operations/service unit) aft, Polyus, after separation from the launch vehicle, ended up flying with its sustainer engines in front. So before the preboost, Polyus had to perform a "flip" maneuver, i.e., a 180° turn in pitch, and then, because of requirements for the control system, a 90° roll. The preboost was necessary because the Energiya launch vehicle itself couldn't place the payload into orbit. So Polyus had to move itself into the proper orbit with its own propulsion system.

The Aims and Objectives of the Flight

What kind of a mission program could a space vehicle that came about so suddenly have? What would the immense space inside the special-purpose module be filled with?

Basically, for a spacecraft of that size, some rather worthy objectives were found, especially considering the brief amount of time given for their formulation and execution. Serving as the basis for their choice was the proposed cycle of existence itself of Polyus as a space vehicle, which consisted of three stages: liftoff by the launch vehicle (powered segment), preboost to orbital velocity after separation from the launch vehicle, and orbital flight.

The No 1 objective was to perform a check of the principles underlying the creation of a 100-ton space vehicle being lifted by the Energiya launcher (i.e., with asymmetrical positioning)—after all, ahead lay the development of a new, long-duration orbital station, Mir-2, which would use such modules.

Plans called for working the bugs out of future systems, among them a docking system. For that, Polyus was outfitted with equipment that registered the parameters of relative motion in the final phase of the docking approach and operated in the radio and optical ranges; bugs in the measurement gear would be worked out by firing two types of reflectors (so-called targets) from the craft—small inflated spheres and angled reflectors located in two side units of the spacecraft. That work would be done in orbit.

Finally, plans called for conducting the most varied of geophysical experiments on all stages of the flight of the rocket-space complex. Observation of the course of the experiments would be from the ground and from flying and floating stations.

The main science objective was to study the interaction of artificial gas and plasma formations with ionospheric plasma. (Such research had begun back in the 1970s in the United States.) Polyus carried a large amount (420 kg) of a gaseous mixture of xenon and krypton (42 tanks, each with a 36-liter capacity) and a system for releasing the mixture into the ionosphere. Three barium plasma generators were also carried, for studying the mechanism underlying pulse transfer from cloud to ionospheric plasma.

The Short Life of Polyus

In July 1986, Polyus was already at Baykonur Cosmodrome. At that time, many sections of the vehicle were still half empty, but the main things had been done—the space vehicle was ready for tests at the proving ground and for subsequent mating with the Energiya rocket.

At the same time, the ground-based experimental checkout of the systems, units, and assemblies was coming to an end (11 different types of tests were performed). Because of a delay in the preparation of the rocket, the mating didn't take place until 3 February 1987, and that signalled the beginning of the existence of the Energiya/Polyus rocket-space complex. Between then and 15 May, the complex underwent preparations on the launch pad, where, primarily, the joint operation of the Energiya systems and the launch-complex systems were checked out.

Several days before the launch, M. S. Gorbachev paid a visit to the proving ground. Some words suitable for the moment were said, but it was decided not to "push the button" while he was there. Fearing that they would compromise the peaceful declarations of the country's leadership, they cancelled the entire program of in-orbit research aboard the Polyus spacecraft—if someone had wanted to, they could have easily interpreted it as an attempt to create a weapon in space.

They "pushed the button" on 15 May 1987 at 2130 hours, Moscow time. The results of the launch were made known, but not all of them—only those that pertained to Energiya. So how did Polyus behave in flight?

The "flip" maneuver initially went as planned, but after the 180° turn, it didn't stop, because a control-system instrument didn't cut in properly. At the designated moment, the preboost propulsion system cut in on the vehicle, which was still rotating. Polyus, not having gained the proper velocity and not entering orbit, continued its flight along a ballistic curve and ended its flight in the South Pacific Ocean.

Of course, its creators experienced quite a few bitter minutes: it was very vexing that all that intense, interesting work should end so "suddenly."

Someone long ago said, "He who makes no mistakes never tries anything." But that is little consolation to those who know that no technology, especially space technology, can survive "arbitrary" methods of development. It forces the staffs at enterprises to work on the edge, and sometimes beyond the bounds, of reasonable risk. That, apparently, is the principal lesson taught to us by Polyus.

Mistakes are always possible, but there must be a system for identifying them. Such a system was created long ago and works well, and in normal conditions, such a mistake probably would have been detected before the launch. Usually, the validity of the logic of the control system and other electrical systems and the correctness of their design are checked out in several stages. First on an electrical mockup by the head enterprise where the electrical circuitry for the entire onboard system is assembled with actual instruments, and simultaneously—on integrated test stands at enterprises—by the developer and the manufacturer of the control system. After assembly at the manufacturing enterprise, the "article," with all the standard systems, goes through the measurement-and-testing station (the measurement-and-testing stage). Finally, at the proving ground, in the tech areas, there is a cycle of independent and integrated tests of the space vehicle, which has already been prepared for flight, and the purpose of those tests is a final checkout of the onboard-system operating modes.

But instruments for Polyus onboard systems and, especially, for the control systems simply didn't exist—it would have taken years to manufacture them. That is why a spare set of instruments was used for putting the vehicle together, and they came from Kosmos vehicles, which had already been manufactured and whose shelf lives had already expired. An electrical mockup did not exist in the KB Salyut—at least, not in the accepted sense—because the electrical mockups of instruments had been sent from KB Salyut to the enterprises developing and manufacturing the control systems for the assembly of the integrated stands. The tests at the measurement-and-testing station at the Khrunichev Plant—again, because of deadlines!—were combined with the independent and integrated tests at the cosmodrome. And finally, the results of the tests conducted there in full complement and in real time were analyzed only for key junctures (again, because of the race against time). Thus, the only place where the mistake could actually have been found was the enterprise that manufactured the control system (the weakest link!).

There were probably some specific individuals at that enterprise who were at fault for what happened, but the main thing was that the entire system of testing was faulty and therefore didn't work. Thus, a piece of hardware takes vengeance for the violation of the principles of its development: if you don't modify something properly, don't check it out, don't find the time to perform the testing—then you get a sad result!

The country's and the sector's leadership were very irritated by the failure of the planned program (after all, when M. S. Gorbachev was there, assurances had been given that the article had been prepared properly!). Needless to say, "organizational measures" followed immediately: many specialists and officials of all ranks who had participated in the work (and even more who hadn't) were punished. Some of those who worked in the testing service and had overseen the modification of the instruments were penalized, some were reprimanded, some were reduced in rank. And, of course, no one received any prizes or awards for their feverish, two-year-long, under-the-deadline work. The hundreds of staffs that had created Polyus were not even given a word of thanks. And nobody ever said another word about Polyus.

In fact, that launch provided a wealth of experimental material. First, it confirmed the efficiency of the superheavy launcher with a lateral, asymmetrically mounted injection payload, which helped in the 15 November 1988 tests of the

Buran orbital craft. Second, it provided an immense amount of reliable information on the preparation and launch of the Energiya rocket-space complex, again used in the launch of Buran. Third, it began testing of a 100-ton class of space platform suitable for handling the most varied of tasks.

One could say that the main objective of Polyus was carried out, but certain conclusions that I would like to mention suggest themselves. The entire history associated with the creation of Polyus indicates that there was no long-term program in the country for creating space hardware that would meet the needs of the economy. We didn't have any organization involved in ascertaining those needs and, based on that, planning the development of space hardware. Hence the creation of the virtually unnecessary to this day Energiya/Buran complex and the appearance of urgent, unexpected assignments like Polyus. In the creation of rockets, "arbitrary" methods of leadership, which involve in their wake the nerve-wracking, feverish work of many thousands of people, are unacceptable. They create the conditions for these kinds of shameful mistakes.

And something else. When large amounts of money and effort have been spent and the needed scientific-technical research for the development of new vehicles has already been created, we need to make every effort to use it for the needs of the economy. For example, we could create in-orbit "factories" for the production of materials with new or improved properties where high energy output and immense mass are required. If we don't begin that work today, then in four or five years, our space-based production, not even born yet, will be behind the rest of the world, and we will hardly be able to close the gap quickly. In which case, the world market for new materials will likely be formed without us.

KB Salyut's Phased Development Program for Materials Processing Spacecraft

937Q0057 Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 92 pp 18-25

[Article by V. V. Pallo, deputy general director of KB Salyut, under the rubric "Space Program": "KB Salyut's Program. The Reaches of Space, or Just Space Mirages?"; first paragraph is source introduction]

[Text] **In recent years, we have finally begun to "get a look at" formerly nameless and faceless enterprises of the space industry: NPO Energiya, NPO Mashinostroyenie, the Khrunichev Plant. There's also the KB Salyut, which, like the other firms, is trying to solve the many problems that are now facing the space program.**

KB Salyut: Yesterday and Today

KB Salyut has been keeping its annals since March 1951, when the aircraft-building enterprise was founded to specialize in the development of heavy strategic bombers. General Designer V. M. Myasishchev became its head. Under his guidance was created equipment such as the long-range ZM (M4) bomber—which, by the way, is still in operation today—and the first supersonic bomber, the M50. In 1960, the enterprise was converted into an aerospace bureau headed by Academician V. N. Chelomey. There, in the 1960s and 1970s, was created the Proton, the most reliable launch vehicle in the world to this day (more than 200 launches), and the production of heavy, 20-ton spacecraft got under way. In the 1970s and 1980s, the bureau, working either independently or in collaboration with NPO Energiya, developed and launched the Salyut and Mir orbital stations, a number of space vehicles of the Kosmos series (Kosmos-929, -1267, -1443, -1686), and the Kvant, Kvant-2, and Kristall modules. Right now, the Spektr and Priroda modules are in preparation. The years 1986 and 1987 saw the creation of the first 100-ton space vehicle, Polyus, which, on 15 May 1987, went aloft in the first launch of the Energiya launch vehicle. Today, the enterprise is headed by General Designer D. A. Polukhin. Thus, the spectrum of jobs handled by the KB Salyut is very broad—the creation of launch vehicles of various classes, of upper stages for putting space vehicles into deep space, of transport craft and orbital stations, and of return vehicles and reentry capsules.

Obviously, the launches of those space vehicles also requires a flight control center; tracking stations in Russia, Ukraine, and Kazakhstan and on ships at sea, and much more. For that reason, there is an objective need to keep the space sector a common sector for the entire economic expanse of our country, and the tasks facing the space program must be consolidated. Right now, of course, "republic-based NASAs" are needed where there are elements of the space sector. Their activity could be coordinated by an agency like the European Space Agency. But the revenues from space activity would be shared in proportion to the contribution made to the entire complex by each republic.

At the same time, until new forms of administration of the space program are created and various issues between independent states are resolved, the sector must somehow function, and for that there must remain at least of minimum level of financing so that highly skilled sector personnel will not run around looking for money and work.

That is why KB Salyut is not waiting for all those issues to be resolved and is trying to find its "niche" in terms of what it does, having developed initially several projects that will be able to serve as the "bricks" for the building of the "bright future" of the Soviet space program.

Just What is This Production in Space?

All signs—that is, the many experiments conducted by us and by those abroad—point to the approach of the era of space factories in which the in-orbit production of materials with improved and new properties will be set up. At present, experiments are being conducted in the USSR aboard the unmanned Foton spacecraft and the Mir orbital craft (ZEMLYA I VSELENNAYA, 1991, No 6, p 34) and in the West aboard the Space Shuttle. On the horizon are specialized vehicles for research and experimental in-orbit production of small quantities of materials with improved properties: the NIKA-T in the USSR, the Eureca in Western Europe, and the Industrial Space Facility in the United States.

Samples of materials produced thus far have considerably better properties that those produced on the ground, but the

economic advisability of the in-orbit production of materials has not yet been ultimately confirmed. That is not only because placing a cargo into orbit and bringing it back is very expensive, but also because existing production units are not advanced enough and manufacturing processes are not well enough developed.

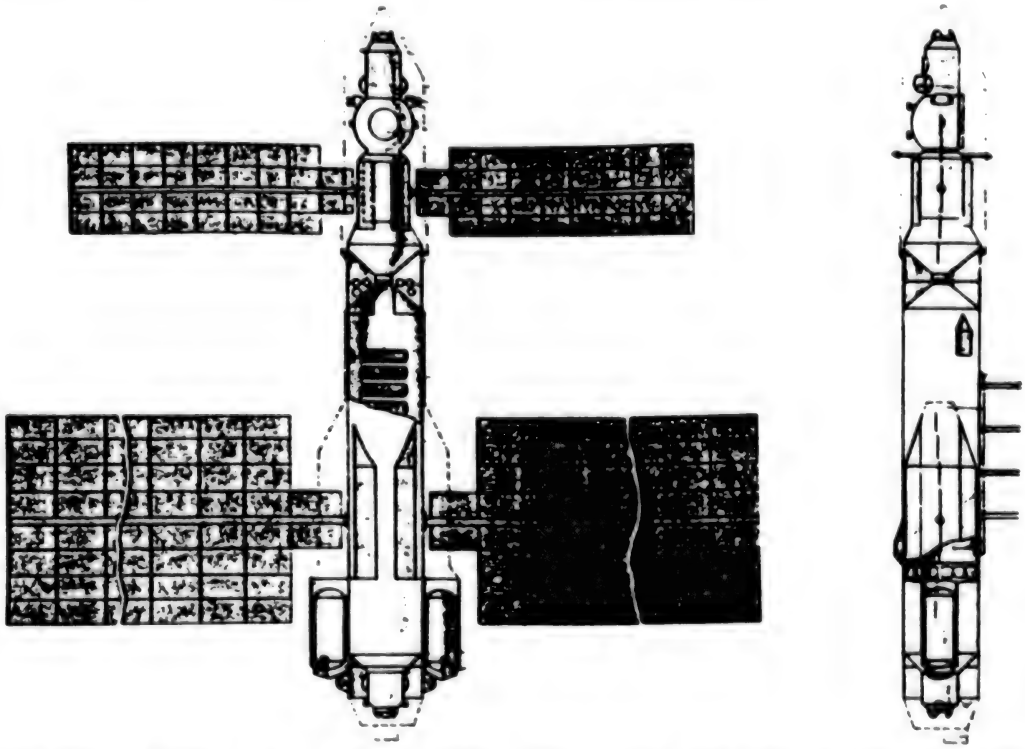
Several conditions must be met for successful in-orbit production of materials: space factors must be present (weightlessness and vacuum), manufacturing requirements must be met (a minimum level of overloads, a high level of power, and lengthy process), and equipment must have certain capabilities.

Researchers in materials science, biotechnology, and fluid physics present rather strict requirements in terms of the "quality" of the weightlessness. True weightlessness aboard a spacecraft is determined by a multitude of factors of natural and artificial origin. That is why ideal weightlessness can be achieved only at points coinciding with the trajectory of the center of mass of the vehicle. Any deviation from the center causes a gravity gradient that increases with distance from the trajectory of the center of mass. Practically speaking, that means that all the production units need to be located in the spacecraft's center of mass, which, of course, is not feasible. Among the other natural factors affecting the level of weightlessness are the rotation of the spacecraft around the center of mass and braking in the residual atmosphere of the Earth. However, periodic and random disturbances caused by the ship and, especially, the crew cause the greatest problems. From all that it follows that in terms of providing weightlessness, the best spacecraft for in-orbit production will, of course, be a free-flying unmanned platform. Such a spacecraft can provide a level of gravitational acceleration no higher than 10^{-5}-10^{-6} g.

The production of materials for microelectronics is very labor-intensive, and that requires dozens of kilowatts of power, sometimes uninterruptedly for several months at a time. Only at such power levels, for example, can "samples" of high quality and the needed diameter (100 mm or greater) be produced. For purposes of comparison, the average level of power supply to the orbital station Mir is 3-4 kW and to the American Shuttle, 7 kW.

Various materials also require various work cyclograms for the production units and their smelting units, for the duration of the processes varies from several hours to several months. In the interval between cycles, the vehicle's orbit is corrected, the solar arrays are adjusted, and other dynamic operations are performed.

Aboard the space vehicle, there must be systems for the prompt return to the ground of the samples that are made in the production process. Such systems can be special ballistic return capsules that have already been developed. The integrity of the materials in them is preserved through the choice of braking and landing modes. All that time, a given temperature and a given humidity are maintained aboard the capsule. Since there will be no people aboard the orbital factories, the materials are loaded aboard the capsule and jettisoned automatically.



Engineering production module (TMP). Lifted by Energiya launch vehicle; launch mass, 101 tons; orbital mass, 88 tons; mass of production equipment and expendable materials, 25 tons; service life, five years; power capacity (voltage 28.5 V), 5-12 kW; power capacity at 115 V, 26-57 kW. Orbital parameters: altitude 380-400 km; inclination, 51.6°. Operational mode, unmanned; crew visits, one or two per year; microgravity level in production- equipment area, 10^{-5}-10^{-6} g.

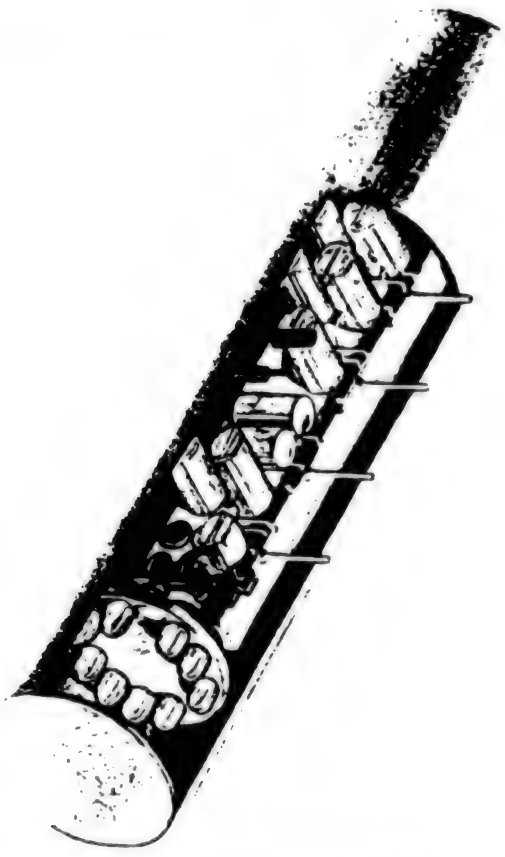
Finally, it is desirable that the orbiting factory operate in orbit for five-10 years. During that entire time, not only the production facilities, but also the ship's systems themselves must be kept in working order. That can be done if the spacecraft is made so that a crew can make short visits for repairs or preventive maintenance. That means that the spacecraft must have systems for docking with transport craft and for crew life-support.

A Heavy Craft Is Needed

Analysis of the requirements has shown that they can be satisfied only by creating a long-duration (approx. 10 years), heavy (approx. 100 tons) man-tended space vehicle with a power capacity (approx. 60 kW).

Such a space vehicle has already been designed. It is called the "engineering production module," or TMP.

That 100-ton vehicle can be lifted with the Energiya launch vehicle. Since the Energiya itself cannot put the payload into orbit, that task will be performed by the TMP's propulsion system. That configuration has already been perfected and was confirmed during the first launch of the Energiya, on 15 May 1987 (ZEMLYA I VSELENNAYA, 1988, No 4, p 5), with the Polyus space vehicle, and the experience garnered in the creation of the latter vehicle formed the basis of the design of the TMP.



TMP module production unit

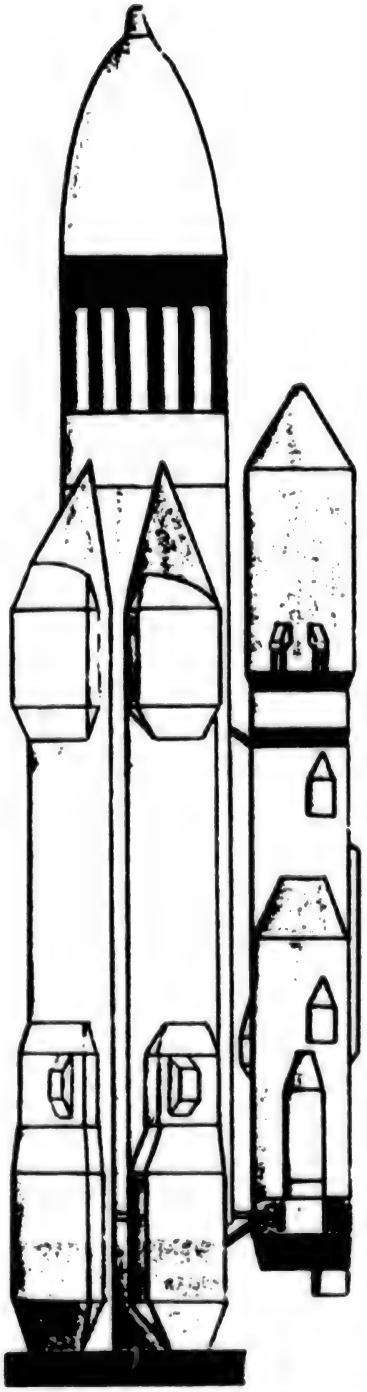
Only with a TMP that size can the requirements for an orbiting factory be met. With a launch mass of 101.9 tons, some 88 tons can be put into orbit, which will make it possible to install aboard the vehicle a production complex and expendable materials that, together, weigh a total of 25 tons. It is expected that the basis of the production complex will be formed by the Krater-type thermoelectric furnaces that are now undergoing testing aboard the Mir complex. The simultaneous operation of several production units will be supported by a power-supply system of increased efficiency (at 115 V) based on solar arrays with a total area of 500 sq m and an average output of 35 kW (rated capacity = 60 kW). The production units will be located in the zone of the center of mass of the vehicle. The large size of the factory (40 m in length) will make it possible to move the sources of vibrations away from the production units, and the automation of the operations within the production cycle will help to preclude the presence of people aboard the space vehicle during the "baking." Thus, the most substantial of the vibration sources affecting the production process are eliminated. In combination with properly chosen modes of orientation and propulsion-system operation, the measures adopted will ensure a range of accelerations aboard the vehicle during the production process of 10^{-5}-10^{-6} g, which is quite adequate for achieving a high quality in the materials that are produced.

The finished product will be delivered to the ground in either ballistic-type or gliding-type return capsules that each hold up to 140 kg of materials. The materials will be loaded into the capsule automatically, with an onboard manipulator. A second manipulator will move the capsule from a special transporter to the airlock, from which it will be jettisoned toward Earth. In the dense layers of the atmosphere, it is stabilized aerodynamically, and a parachute is used to effect a smooth descent and the landing.

Cosmonauts will be able to work aboard the TMP for up to 10 days, and they, along with expendable materials and spare parts, will be delivered to the TMP by either the existing Soyuz-type craft or by multipurpose orbital aerospace planes (MAKS) designed by NPO Molniya (ZEMLYA I VSELENNAYA, 1991, No 3, p 19). The MAKS consists of a booster section with an orbital airplane (the second stage) and the already existing AN-225 Mriya carrier aircraft (serving as the first stage).

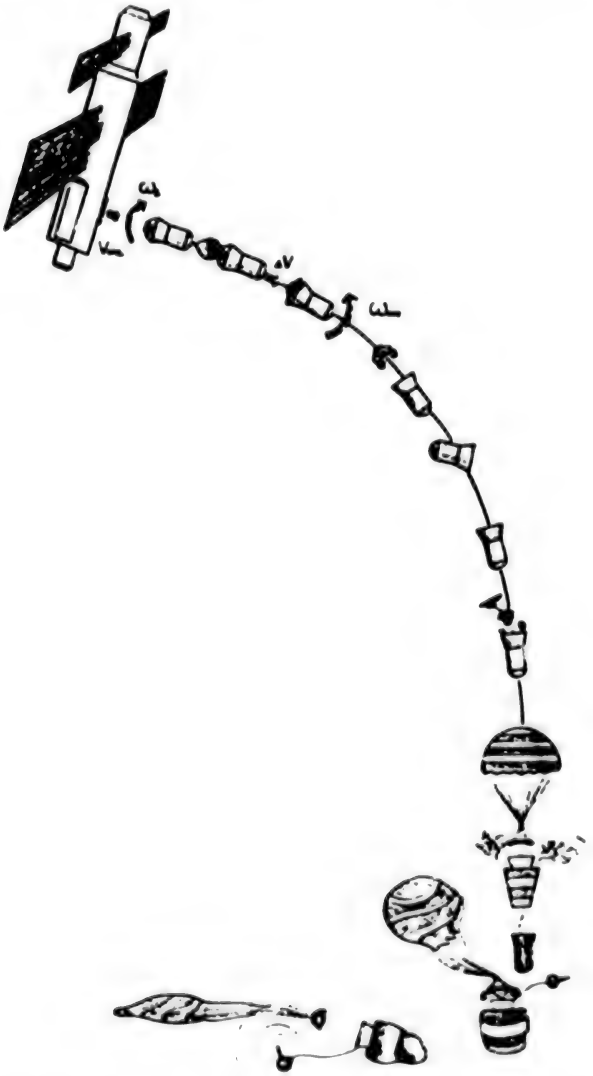
Such an orbiting factory will make it possible to produce and deliver to Earth 1-2 tons of materials a year.

Right now, everything is ready for the realization of that project, since elements already developed form the basis of it. Of course, some of the problems can be overcome. The creation of such a factory would take six or seven years. But who needs such a factory? To answer that question, we will have to digress a little away from the equipment itself. The cost of creating the factory—i.e., the amount that will have to be spent during its working design, manufacture, testing, and operation, which will be about 15 years—is, according to KB Salyut estimates, about 1.5 billion rubles [R] (in 1990 prices).



TMP module attached to launch vehicle

That's a lot of money, and to determine whether it can be recovered, we will have to talk a little about the materials that will be produced aboard the factory.



Profile of operation of return capsule of TMP module

What Can an Orbiting Factory Do?

At present, to produce a new level of quality of instruments used in microelectronics and in laser and infrared hardware requires materials with a new level of quality. Such materials are limited at present to a rather small circle: germanium, silicon, gallium arsenide, zinc oxide, cadmium sulfide, cadmium telluride, mercury diiodide, MMT alloy (manganese-mercury-tellurium), and, perhaps, a few others. For the optics industry, it is possible to manufacture flat optical gradan-glasses [steklo-gradan] whose manufacture is basically impossible on the ground. Finally, in biotechnology, weightlessness makes it possible to produce protein crystals, and in terms of drug production, the most enticing is the production of a large amount of highly efficacious drugs for the treatment of diabetes, cancer, anemia, pediatric growth diseases, and other illnesses.

But on the yet-to-materialize market for such materials—the domestic market, as well as the foreign market—theconditions are very changeable: today, it seems, certain materials need to be produced, but tomorrow, the situation changes. For that reason, the prices at which the materials produced can be sold can vary widely.

That is why in order to have a guaranteed economic return, various materials must be manufactured aboard the orbiting factory, in a flexible program of operation of a production complex intended for making maximum profit. But even the most conservative estimates indicate that over five years of operation, the spending will be covered, at least twice over, by the revenues from the sales of the materials produced (and that without consideration of the possible value of the biopreparations—where fluctuations in price are rather considerable).

Clients are needed for the realization of that program. So just what is the situation with them?

As it turns out, the former Ministry of the Electronics Industry had preferred investing money—and much more than is needed for an orbiting factory—into the development and improvement of ground-based technology for such materials.

The medical profession has a different problem—even after they receive promising drug materials from orbit, it takes them at least three-five years to convert the materials into drugs.

Thus, not a single potential client wants to put up money, apparently, for this promising project.

Aware of the complexity of the problem of financing the operations, the Salyut Design Bureau is proposing its own program of gradual development of space-based production.

First, for purposes of perfecting in-orbit engineering processes, use missiles decommissioned from military duty by the strategic arms limitations treaty between the USSR and the United States. In place of the warhead, a 1.2-ton space vehicle can be mounted on such missiles, and the space vehicle, placed into low orbit, could create the conditions for, say, developing biotechnology for a brief period of time (45 minutes to six hours). In that period of time, as much as 50 grams of ultrapure biomaterials could be produced and, in a return capsule, then returned to the ground. Such a project is rather simple and inexpensive and could be realized as early as 1993-1994.

Second, build 20-ton unmanned space vehicles to be lifted by the Proton launcher to an orbit as high as 500 km and to remain in operation for up to five years. Of the space vehicle's total mass of 20 tons, around 10 tons could be used for performing various research and experimental operations and for effecting experimental and semiindustrial production of biomedical preparations and ultrapure substances, as well as other materials for the optical and electronics industry. KB Salyut has performed in-depth studies of two versions of such vehicles: the Tekhnologiya and the Orfar ("**Orbital Pharmacist**"). The Tekhnologiya vehicle already has a prototype—the Kristall module, which is now in operation in orbit as part of the Mir complex. Return of the finished product and the production units to the ground is to be done with small and large return capsules that can be re-used. The Orfar has a different configuration—it itself is the return module. The advantage it offers is the re-use (as many as 10 times) of virtually the entire vehicle and the production units, which are readjusted and loaded with the initial material while they are on the ground.

The cost of building each of those vehicles is comparable with the cost of the Kristall module now aloft. The Orfar design is more complex in terms of development (because of the reentry of a large spacecraft), but it is more efficient and flexible in its operation. The creation of each of the vehicles is entirely feasible within a four-five-year period—after all, the technical research is already on hand.

Thus, the following program is being set up:

1. A 1.2-ton facility that is a short-duration facility (up to six hours) and sends up to 100 kg of payload to the ground is being added to the existing Foton space vehicle, which has a lifetime of two weeks and from which 60 kg of payload is returned.

2. After that, the Nika-T space vehicle may be built, and its capabilities will be broader: lifetime of up to six months, payload capacity of up to 2 tons, power output of about 5 kW, mass of payload returned of 1,200 kg.

3. Crew members are being used aboard the Mir complex now aloft to continue to perfect materials-production techniques and the production units themselves.

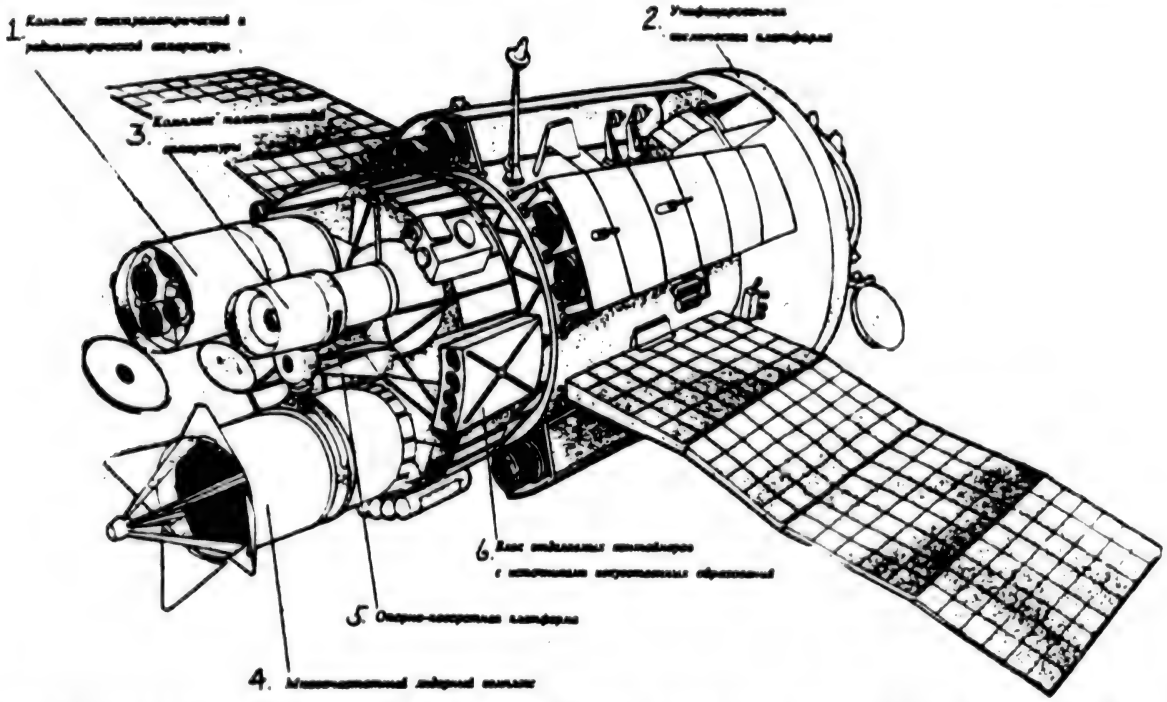
4. The 20-ton Tekhnologiya and Orfar vehicles will constitute the next class of space vehicles. Duration of flight (up to five years), power capacity (9 kW), and lower vibration levels will create new possibilities for production. On them we can already try various combinations of production units and materials for the purpose of mastering experimental production.

5. And, finally, as a logical culmination of the efforts—an orbiting factory, with advanced units in unmanned mode and with semiindustrial scales of production.

Of course, also possible are additions to the program from other firms that are also seeking application of their own capabilities.

In addition to the designs described and included in the program, KB Salyut has developed another design based on the "20-ton facility."

The multipurpose Tellura-EKO space station could become a fundamentally new system for the integrated study and monitoring of the state of the environment—the Earth's surface, the near-Earth medium, and near-Earth space. It would be the first to provide for the use aboard a spacecraft of a universal, multifrequency lidar complex for remote sensing of the Earth. The Tellura-EKO vehicle has a mass of 20 tons, of which 10 tons can be for payload, and it develops up to 5 kW of power in continuous mode. It would be lifted by the Proton launch vehicle to a working orbit 400-450 km high with various inclinations (52°, 65°, 72°). The vehicle could be built before 1995 and would be in operation for

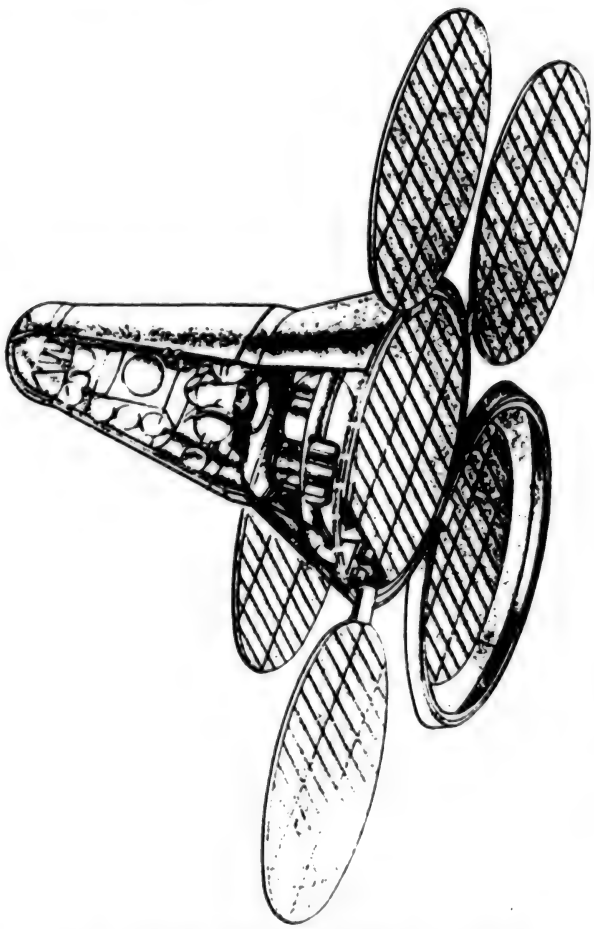


Design of Tellura-EKO orbital station. Lifted by Proton launcher; station mass, approx. 20 tons; payload mass, up to 10 tons; power capacity in continuous mode, up to 5 kW. Orbital parameters: altitude, 400-450 km, inclination, 52°, 65°, 72°. Station carries universal multifrequency lidar complex: emissions wavelengths, 10.6 μm, 1.06 μm, 0.76 μm, 0.3-0.5 μm; pulse energy, 1-10 J; pulse duration, 0.01-1.0 μs; maximum pulse frequency, 50 Hz; scanning angle, up to 50° Scan width: 800 x 9000 km in survey mode and 800 x 100 km in sensing of frontal processes.
Key: 1. spectrometer/radiometer complex—2. consolidated space platform—3. television complex—4. multifrequency lidar complex—5. steerable reference platform—6. unit with jettisonable containers with sources of artificial formations

five years. By comparison with the money our society is losing because of insufficient information about the processes taking place on the ground and in near-Earth space, to include anthropogenic processes, the amount of money spent to build the vehicle would not be much. For example, even the use of information about already existing space systems makes it possible to produce in the economy an economic impact estimated in the hundreds of millions of rubles.

The station is developed on the basis of the 20-ton vehicles that have already been developed in KB Salyut and have been successfully used. But generally speaking, spacecraft with the most varied of applications can be created on the basis of those vehicles. They consist of two basic sections: a special section that includes equipment that performs special-purpose research or production tasks, and a service section that is itself a consolidated space platform. Any payload with a mass of up to 6 tons can be placed in the special section.

Much more could be said about the possibilities of the use of space vehicles created in KB Salyut—particularly, vehicles for all types of satellite communications, which is badly needed for the immense expanses of our country—but the feasibility of all such projects today depends solely on financing, i.e., on the availability of real clients. If such clients do not appear, the reaches of space opened primarily by KB Salyut could easily become space mirages.



Orfar returnable production module. Lifted by the Proton launch vehicle; orbital mass, approx. 20 tons; mass of production equipment, up to 2 tons. Orbital parameters: altitude, 400-450 km; inclination, 51.6°; power output, 5-12 kW; duration of single flight, up to 1 year; number of subsequent launches, 10; productivity of production equipment over course of one flight, up to 600 kg

Prospective Reusable Aerospace Systems Discussed

937Q0002 Moscow NEZAVISIMAYA GAZETA in Russian 29 Sep 92 p 6

[Article by Andrey Vaganov, under the rubric "Space Program": "'Buran' Has Finished Its Business: Now It Could Die Very Soon"]

[Text] In the settlement of Mendeleyevo, near Moscow, the first international aerospace conference "Prospects of the Exploration of Space" (IASC-92) will take place from 28 September through 2 October. The conference organizers—The International Engineering Academy and the Russian Federation Engineering Academy, the Russian Academy of Sciences, the Institute of Mechanical Engineering, the Space Academy, the Ukrainian National Space Agency, the firm Antonov ANTK, and the Yuzhnoye Design Bureau—have announced that more than 500 papers were submitted from 63 different organizations and firms.

Undoubtedly, a central place in the discussion at the conference will be taken by the problem of how to convert space from a field of purely scientific research into a profitable sector of the national economy. And that means, primarily, solving the problem of putting a payload into orbit for substantially less money. And although the expendable rocket will be the main means of launching satellites until the end of this century, it seems that we should begin now to analyze the effect that reusable systems have had on the face of space vehicles.

The problem, as they say, has ripened and overripened, especially for Russia in its current economic condition. After all, some 17 million hectares have been dispossessed just for the landing and launch of spacecraft, and half of it is very fertile soil. Until now, the cost of "leasing" that land has not been factored at all into the expenditures of space programs.

Nevertheless, it is Russia today that has the biggest scientific and technical stock of research in the world with regard to reusable space systems. And that doesn't just pertain to what has become the almost legendary Soviet space shuttle, Energiya-Buran. Its one flight, in November 1988, which, by the way, was performed on an extremely high scientific-technical level, has not, alas, removed many of the purely economic doubts about the wisdom of continuing to develop such systems in the future. Gleb Lozino-Lozinskiy, the Buran airframe developer and general director and general designer of the Molniya NPO (Moscow), has said that another launch of Buran in unmanned mode is planned for the second half of 1993. But after that...

Gleb Yevgenyevich [Lozino-Lozinskiy] himself is vigorously pushing the idea of a multipurpose aerospace system (MAKS). The first stage is the AN-225 Mriya carrier-aircraft. The second is a reusable orbital airplane and an expendable external fuel tank. According to estimates, MAKS will cost roughly 2 billion rubles [R] at the prices existing in the first half of 1992. At NPO Molniya, MAKS has already gone through the stage of preliminary design.

The prospects of such a system, by the way, are indicated by the fact that the European Space Agency, or ESA, is seriously rethinking the fate of the French Hermes shuttle (a system similar to Buran). There are reports that ESA specialists have reached the conclusion that the Hermes project is already obsolete. In the near future, the French may approach us with a proposal for a joint project involving a reusable aerospace system.

Such a project, the Russian-British project Mriya/Interim Hotol, is already under vigorous study. Essentially, it consists in replacing the second stage, with its expendable external fuel tank, with a fully reusable orbital airplane with built-in fuel tanks.

Gleb Lozino-Lozinskiy does not deny that a situation could come about in which that same France would launch its own shuttle into space on the shoulders of Russia. In his opinion, the most important thing here is to not sell below cost and to

try, with a joint project, to obtain from foreign partners sums of money that would enable us, to some extent at least, to maintain our own space programs. In that regard, certain hopes are being pinned on help from the Russian Space Agency.

At any rate, the functionaries of the RSA will have to strain to force Western partners to cough up the money. After all, the latter are attracted primarily by the cheapness of the work force in Russia and, at the same time, by the high technical level of the available equipment.

Comparative Characteristics of Aerospace Systems

	MAKS (CIS)	Ariane V/Hermes (France)	H2/Hope (Japan)	Sanger-2 (Germany)	AN-225/ Interim Hotol (CIS-Britain)	NASP (U.S.)	X-30 (U.S.)
Launch position	Horizontal	Vertical	Vertical	Horizontal	Horizontal	Horizontal	Horizontal
Total mass, tons	620	620	260	366	600	180-230	125-135
Mass of first stage, tons	345	596	252	254	350	-	-
Mass of orbital stage, tons	27	24.8	10	112	250	180-230	125-135
Payload, tons	8.9 (9.9)	3	3	3 (7.7)	-	912	-
Crew, no. of people	2/unmanned	3	unmanned	4/unmanned	unmanned	manned	unmanned
Development completed, years	1996-1998	1997-1998	1996	2010	2003	2001	1997

Space Designers Discuss Uses for Buran, Prospective Aerospace Launch

937Q0025A Moscow RADIKAL in Russian No 37, Oct 92 p 11

[Article by Aleksandr Trutnev and Yuriy Stepanov: "From Space - to Aerospace"; the first two paragraphs are an introduction]

[Text] The First International Space Conference, held under the motto "Man-Space-Earth," is ending its work. In addition to the results of the conference, which are cited below, the readers of RADIKAL are probably interested in what Russian scientists did there.

Our correspondents were able to gather for a roundtable discussion Gleb Lozino-Lozinskiy, doctor of technical sciences, laureate of State Prizes, the general designer and director of the Molniya Scientific Production Association; Aleksandr Tarasov, chief designer, candidate of technical sciences; Vladimir Skorodelov, deputy chief designer; and Andrey Yakovlev, corresponding member of the International Engineering Academy, chief scientific secretary of the International Engineering Academy.

G. L.-L.: The activity of our scientific production association in the minds of many is associated for the most part with work on development of the Energiya-Buran system. I will not speak of this in detail because a great deal has already been written on the fate of the system.

I want to emphasize only one thing: the experience of work with the Buran and the continuing development of aerospace systems served as a basis for the Molniya Scientific Production Association taking an active part in the First International Space Conference.

What are we working on now? After the rates of further work on the Energiya-Buran system began to drop off due to reduction in the volume of financing, the Molniya Scientific Production Association was forced to try to apply its energies in the following directions: maximum possible use of the already tested Buran in the economy and the development of the aircraft necessary in this same economy. We will naturally continue the development of aerospace systems.

In particular, the system of the generation following the Buran will make use of much that was developed for it. The first stage is a Mriya aircraft of the Design Bureau imeni Antonov, in essence, a mobile launch ensuring a possibility for creating a mass of the second stage in a range up to 275 tons and use of the network of already operative airfields. The launchings can be made in a wide range of stipulated points and this is extremely important so that if it is necessary to make an urgent docking with spacecraft it can be launched in the plane of that vehicle with which this operation must be performed.

Now we are approaching the development of an aircraft with a load-lifting capacity even greater than the Mriya; this is the Gerakl with a capability for air transport of up to 450 tons with a takeoff weight of 900 tons.

A. T.: I also would like to mention our conversion activities with which we have been concerned during recent years. Now construction of the Molniya-1 aircraft is being completed. This is a triplane with the engines at the rear and with folding wings. It has a number of advantages in comparison with aircraft of traditional designs. We flew it to six landing sites. The Molniya-1 can be used very extensively, it is both a taxi and an individual aircraft. The machine also is convenient for transporting the mail and carrying out aerial mapping and geodetic work.... In short, such an aircraft is necessary both in our country and abroad. There are two variants of this machine, depending on the engine installed in the aircraft, Russian or American.

All the parts of the Molniya-1 aircraft have already been fabricated, plants have proceeded to their assembly. We calculate that the first machines will make their appearance

this year. We think that they also will be of interest to private owners. Indeed, the fact is that for the first time in the world we have produced such an economical aircraft: 20 g of fuel per person per kilometer.

V. S.: I would like to tell in greater detail about the future prospects for use of the Buran. We drew up a number of tasks which can be implemented only using this craft. This is opening up new directions in the use of space technology. Some of them are problems in the space technology of production and the use of weightlessness in the development of new materials which cannot be produced under gravitational conditions. This, in particular, includes the production of high-quality semiconductor materials having unique properties, optical systems and glasses; pharmaceuticals and other products. The fact is that the Buran, in contrast to the Shuttle, can execute a flight in an automatic mode. The absence of a crew aboard makes it possible to reduce the level of microgravitational effects on the structure by two orders of magnitude. If man is present on board, he has to move. There is special equipment for man's life support. It also introduces its perturbations into the microgravity background. But an unmanned ship does not have these shortcomings. Ideal conditions are provided for carrying out both experimental research and experimental production. The Buran load-lifting capacity and the power of its electrical supply system are capable of ensuring the carrying out of experimental work which it was impossible to conduct aboard the Mir space station. As a result of the research we concluded that aboard the Buran there can be successful finalization of technologies and production equipment can be developed which in the future will be used in heavy multiton plants in orbit.

Still another new direction in our work is the possibility for return of heavy payloads to the surface. Here it also is possible to consider such a task as the servicing and repair of orbital stations with the replacement of large modules directly in space. That is, the Buran can put them into orbit, dock them to a station, carry away the worn-out parts and return to Earth.

A highly important task is international cooperation in the aerospace sphere. We worked out a program which was designated "MAKS" [mnogotselevaya aviatsionno-kosmicheskaya sistema]—multipurpose aerospace system. In contrast to the launching equipment now existing it is capable not only of putting payloads into orbit, but also its second stage—an orbital aircraft—to perform a number of tasks, including those which earlier had not been solved: the fundamental possibility of ensuring emergency rescue of objects in orbit, assembly of large objects in space from modules and monitoring adherence to international agreements in the space field, including in military activity. Our MAKS also may serve the purposes of collective safety.

In 1990 the USSR Ministry of the Aviation Industry turned to one of the leading British aviation companies with the proposal that cooperation be carried out in research on the concept of developing a two-stage aerospace system for putting vehicles into orbit. The Molniya Scientific Production Association, together with the Central Aerohydrodynamics Institute and the Design Bureau imeni Antonov and other organizations, participated in this work.

We concluded that our MAKS and the British Interim Hotol system are in many respects. The MAKS is the project of the day, constructed from existing materials and on the basis of modern technologies. But the Interim Hotol can be realized only on the basis of promising construction materials. It is evident that they do not compete with one another, but rather successfully alternately fit in with one another in time, supplementing one another. In the cooperation process we found it possible to use the sustainer engine from the MAKS in the British system. This will make possible standardization of both projects by 60- 70 percent. Accordingly, validation appeared for the technical feasibility of combining these projects. Work is being carried out in the field of economic validation of such a unification.

The British side perceived this concept in the following way: it proposed that the materials for the MAKS project be examined by the European Space Agency for the purpose of joint development of such a system with a role being played in this by Russia, the Ukraine and a number of other European countries.

A. Ya.: Soon in Brussels there will be a conference of the European Economic Community and very large European companies at which there will be discussion of the prospects for cooperation with Russia in the space systems field. This became possible after direct contact between leading specialists of the Molniya Scientific Production Association and colleagues from France, Germany and Great Britain. Such meetings have resulted in a recognition of the need for developing aerospace systems as the least expensive and most promising way for the further study and conquest of space.

Today it is necessary to proceed from unique but risky space flights to planned and relatively inexpensive, at least profitable, use of the possibilities of space in the economy. The interest of both a number of countries and development enterprises in obtaining profit from the implementation of new space projects has led to an awareness of this new direction in space research. Many scientific organizations in the country and the best people of the International Engineering Academy, Ukrainian Engineering Academy, Space Academy, etc., have been attracted to work on these projects. Commercial organizations also are interested in the conquest of space. The commercialization of space programs would be a very powerful stimulus for them. That is why aerospace, making it possible to invest money with unquestionable profitability, represents a new stage in the development of all cosmonautics.

Cosmonaut MMU Not Suited for Work on Mir Station

937Q0017 Moscow GUDOK in Russian 11 Sep 92 p 3

[Article by Boris Olesyuk, Moscow: "Why Isn't the Space Motorcycle Being Used?"; first paragraph is source introduction]

[Text] **In early February 1990, the crew of the fifth main mission of the Mir orbital complex made our countrymen happy for a little while with an interesting novelty that inserted a breath of fresh air into the monotonous work in orbit. Cosmonauts Aleksandr Serebrov and Aleksandr Viktorenko, in turns, four days apart, performed comprehensive tests of a mini spacecraft. Officially, it's called the manned maneuvering unit (MMU [SPK] in Russian), but meticulous journalists immediately gave it a shorter, capacious name—the space motorcycle—and it stuck.**

Our cosmonauts have rated the motorcycle's performance highly, emphasizing its soundness and reliability, the ease with which it is handled, and its magnificent maneuvering capabilities.

Let's recall its main parameters. It weighs 218 kilograms. It has 32 miniature jet engines (16 main and as many for backup) that operate on economically pure fuel—compressed air—and that enable a maximum speed of 30 m/sec. The cosmonaut can travel in any of six linear directions and can rotate around three axes. There is a six-hour supply of fuel. The motorcycle is capable of hauling as much as 100 kilograms of cargo, according to the designers.

The space motorcycle was built at the Zvezda Machine Building Plant near Moscow. It is the only enterprise of its kind where all the space suits have been designed, beginning with Gagarin's Berkut and ending with the modern Orlan-DMA, which is used on Mir. In addition to space equipment, the plant develops ejection seats and other devices for our pilots. General Designer Gay Ilich Severin has headed that creative group for more than 20 years.

For what purposes was that individual flying machine developed (more than 20 years ago!)? The motorcycle was created for repair and assembly operations, for inspections of the orbital complex, for helping those in distress, and for delivering cargoes, and it could become an invaluable system for "unfurling solar sails." Those are the jobs that its creator had in mind for his brainchild. But it was created primarily for Buran, and its main purpose was to be used in the inspection of the reusable craft's heat shielding and, in the event that tiles had fallen off, in their replacement. In a word, the design of one of the three Burans called for a "garage" for the space motorcycle.

It was expected that one of the crew members would do an inspection on the motorcycle, since you can't walk about freely on the polished, precisely adjusted, brittle tiles the way you can on the skin of the Mir station. (FYI: the gluing of the heat-shielding tiles onto the spacecraft—there are about 39,000 of them—generally takes about two years of painstaking, jeweler's-precision work.)

But as the first Buran flight demonstrated, the heat shielding on the hull of the craft seems to be fine: only four tiles fell off. That problem seems to be taken care of, and new jobs need to be found for the motorcycle.

It's not hard to see the question: what has happened to the space motorcycle on Mir, why isn't it being used?

To its profound misfortune, after two test flights by Viktorenko and Serebrov, the space motorcycle has not yet found any practical application, even though by now the 20th main mission is aboard the station. What's the problem?

Some funny guy at the Flight Control Center said jokingly that during the last test, the motorcycle got "bogged down" from neglect and won't go anymore. That's not true—it's in good repair, has plenty of fuel, but it's covered with space dust after sitting tethered in the airlock module, as if in a warm garage, for two and a half years now. Moreover, it has become something of a burden to the cosmonauts.

In July of last year, when Artsebarskiy and Krikalev were on the Kvant module, assembling a large conical framework 14 meters high out of structural elements, the motorcycle had to be disassembled into six parts, which had to be placed in the neighboring module. The airlock chamber became a temporary warehouse. It looks as if the same fate awaits the motorcycle when A. Solovyev and S. Avdeyev perform their EVAs. They will have to mount a 700-kg propulsion unit on the top of the tower mentioned above. Designers will try to use that unit to solve the urgent problem of orientation and stabilization of the orbital complex. And they want to solve it with a minimum expense of fuel, using the "big arm" for that.

The Mir station is like a living organism, and it has its illnesses, and inflammatory processes occur, especially since with every year the space machine gets older. Some of the instruments and systems have already worked twice as long as they were supposed to. The repair operations performed by the cosmonauts don't make noticeable improvements. The station has an Achilles heel—the system of power gyroscopes, which are used to maintain oriented flight. The source of the problem is that the onboard computer has gone out of commission. It has been changed out several times already. And without being able to orient the station, astrophysical observations can't be made in space, nor can studies of the Earth from space.

Of course, the usual question is, We really haven't been able to find jobs that could be done with the motorcycle? Needless to say, there have actually been jobs for it, but, sadly, after it was tested, not a single cosmonaut on any of the following seven missions managed to "roll" the motorcycle out of its garage and try it out. And all because, in space, the motorcycle turned out to be poorly suited for hauling cargoes. The designers have a little more work to do in that regard. In fact, how would a single cosmonaut in a space suit, with a gigantic "pack" on his back, be able to handle a cargo in open space? Especially when his arms are resting on elbow rests, and he's using his fingers to press control buttons? And how would he dock and moor? A special attachment is needed. The list of questions requiring thorough study could go on and on. For now, a cosmonaut can only make an inspection fly-around of the complex, but there's been no need for that.

Are the American astronauts using their motorcycle on the Shuttle? I'll say this: the Americans first tested their flying chair, which is what they call the backpack/propulsion unit,

six years ago. They've been using it for operations that bring certain satellites back to the ground for repairs. They've tested their motorcycle on the job more than 10 times. This is how they do it. The Shuttle approaches to within 10-12 meters of a satellite. The astronaut on the motorcycle goes up to the satellite and fastens a locking device to it, and the 15-meter manipulator arm of the Shuttle pulls the satellite into the cargo bay of the craft.

Ballistic-Navigational Support for Guiding Giotto Spacecraft to Halley's Comet

927Q0208A Moscow IZVESTIYA AKADEMII NAUK RAN: TEKHNICHESKAYA KIBERNETIKA
in Russian No 3, May-Jun 92 (manuscript received 13 Jun 89) pp 93-97

[Article by N. M. Ivanov, Yu. A. Kolyuka, V. S. Polyakov and V. F. Tikhonov, Moscow; UDC 629.7]

[Abstract] The problems involved in navigational support for spacecraft flight near the nucleus of Halley's comet encountered by the developers of the West European Giotto project are discussed. However, no effort is made to deal with the full range of mathematical and technical problems; instead, it is the fundamental technical ideas favoring solution of the arising problems which are discussed. The essence of these ideas is the use of data from television surveys of the cometary nucleus registered aboard the Vega vehicles for final guidance of the Giotto to the comet. The mathematical approach and organizational-technical principles for solving this problem, which was the essence of the international "Lotsman" ("Pilot") project, are presented. The results of a fundamental refinement of the ephemeris of Halley's comet are given on the basis of the totality of observations of different types made as a result of implementation of the "Lotsman" project and their contribution to the success of the Giotto mission is evaluated (the interactions between the Vega vehicles and Giotto are described). The precise cometary ephemeris obtained by solution of the "Lotsman" problem served as a basis for final guidance of the Giotto. These data were used in the last correction of vehicle motion on 11 March 1986. The Giotto spacecraft flew near the cometary nucleus on 14 March 1986 at a distance 605 km. Flyby observations indicated that the error in solving the "Lotsman" problem was only 30 km.

Timely Problems in Automation of Development of Software for Built-in Online Control Computers

927Q0208B Moscow IZVESTIYA AKADEMII NAUK RAN: TEKHNICHESKAYA KIBERNETIKA
in Russian No 3, May-Jun 92 (manuscript received 31 Jan 91) pp 98-104

[Article by G. P. Anshakov and Ya. A. Mostovoy, Central Special Design Bureau, Kuybyshev; UDC 629.7]

[Abstract] The most effective directions in automation of development of software for built-in controlling computers for systems for control of flightcraft and spacecraft are discussed. The principles for developing software ensuring its efficient practical utilization are examined. Since the 1970's the "Kulon" so-called technological flow system has been used in developing programs and integrating developers, systems and users. The strengths and weaknesses of this system, which now has become outmoded in many respects, are reviewed. Among the strengths of that system was the matching "in a single individual" of the developer of the system, those preparing algorithms and computer programmers. This has been replaced by the "Kurs" system, which is fully described. It is designed to meet the technological advances of the last decades and those foreseen in the coming decades. The technologies are all ready for practical application at a full scale and even now are ensuring an increase in the productivity of labor by a factor of 1.5-2 or more. A further increase in work productivity will require development of artificial intellect methods in the designing of software, generation of initial data for debugging and improvement in a final user-instrument "friendly interface" complex. References: 3 Russian.

'Zerkalo' Communications Satellite Project To Be Commercially Funded

937Q0006 Moscow LITERATURNAYA GAZETA in Russian No 42, 14 Oct 92 p 13

[Article by Yuriy Markov, spacecraft test engineer: "The World is My 'Mirror,' You Say: Academician Reshetnev's Firm Is Losing Its Monopoly on Communications Satellites"; first paragraph is source introduction]

[Text] **For the first time in the many years I have worked in "space," I got money not from the state budget, not from a ministry, not from the Russian Space Agency, but from some nongovernmental commercial structure. Of course, I was interested in finding out who the rich entrepreneur was who was ordering for himself an extremely complex satellite.**

I didn't have to search long: he turned out to be a recent staff member of our design bureau.

Nikolay Morozov—the director of the firm NST (NOOS Space Technologies Ltd.)—is 50 years old. He graduated from the Bauman Moscow Higher Technical School's Aircraft Department, which is well known in aerospace circles. Morozov worked a while in Chelomey's firm and in the S. A. Lavochkin NPO. In 1992, he was named director of NST, a firm that deals in new space technologies. It's primary business is to create the Zerkalo [mirror] system, a fundamentally new space communications network.

MARKOV: Nikolay Aleksandrovich, it seems to me that there are more than enough communications satellites. For everybody's liking. What's so different about the Zerkalo?

MOROZOV: He who owns the information, owns the market! The exchange of information between exchanges, enterprises, banks, etc., is as necessary as air. But look at our country: telephone communications couldn't be worse. Optical-fiber? It would be complex and horribly long to set up the network. The only thing that'll work is communications via satellite. But not the communications satellite that has existed up to now: it can't furnish high-speed—computer-based!—information exchange. To do that takes increasing the data rate 1000-fold over what it is now!

MARKOV: And how do you hope to accomplish that?

MOROZOV: I'm getting to the main idea of Zerkalo. Right now, a signal going from a communications satellite to the ground is very washed out: it "illuminates" on the surface of the planet a spot that covers a very large area. For that reason, a signal received by a ground station is too weak to transmit a large flow of information. And if you make the beam narrow, precisely pointed at a receiving antenna?

MARKOV: I understand: if you want them to hear you better on the other side of the river, you have to cup your hands into a horn.

MOROZOV: True. We've checked out where the centers of business in Russia and the rest of the world are. If we hang a satellite in geostationary orbit somewhere over the Indian Ocean and if each of 10 independent beams of the satellite were aimed at a business region of the world (not America), then there would be uninterrupted, high-quality communications among tens of thousands of ground stations. An unprecedented worldwide network of satellite communications is forms for the transmission of computer data, voice signals, and video. Africa, Europe, Asia and Australia would be linked together.

MARKOV: And why do you bad-mouth America?

MOROZOV: If it's interested and puts in an order, we'll hand a satellite in the Western hemisphere, too.

MARKOV: Will the ground antenna be big?

MOROZOV: No, just 1.5-2.5 meters across. Any office could mount the antenna on its roof—and get in touch with the whole rest of the world! By the way, the whole ground assembly weighs just about 300 kilograms. And it's very compact, so much so that it takes little time to assemble it.

MARKOV: But why is it that nobody in the world has built such a satellite system before now?

MOROZOV: It takes a great deal of precision to put the satellite in its "parking spot," to stabilize it, to aim it, to "tie in" on its radio beams. Anyway, the presence of two beams that can be quickly re-aimed expands the functional capabilities of the system considerably. Yes, the satellite will be profitable if its active life is five-seven years. And its weight is quite suitable—three tons! For that reason, it will be launched atop a Proton vehicle with a spacecraft control system.

MARKOV: Are other countries working on something similar?

MOROZOV: German specialists tried to develop their own Romantis, but they backed off in the face of its expense—nearly 7 billion German marks. Canadian entrepreneurs, together with our specialists, are developing a program under the name of Sovcan-Star.

MARKOV: And who in our country got the honor of creating the Zerkalo satellite?

MOROZOV: The competition was won by the S. A. Lavochkin NPO.

MARKOV: But that means an end to Reshetnev's monopoly! Why, in our sector, it's like this: manned flights are handled only in Podlipki, the Korolev firm; interplanetary flights, only in Khimki, the Lavochkin firm; satellite communications, only in Krasnoyarsk, the firm of the now prospering Academician Mikhail Fedorovich Reshetnev.

MOROZOV: The market is the market. But there's virtually no competition in our communications market, it's in such lamentable shape. We can already hang as many satellites as we want. The main thing is to build a ground-based communications infrastructure.

MARKOV: How much will Zerkalo cost?

MOROZOV: That's a trade secret. I'll just say this: the cost of the system to a large extent will depend on the effectiveness of the control of the project.

MARKOV: Fine. How many workers are in your firm, and how much on average do they get paid?

MOROZOV: That's a trade secret. And in general, we don't discuss what staff members make.

MARKOV: I see, the trade secret will be a little stronger than the secrets of the recent past. So, what else would you like to say?

MOROZOV: That more than 1,500 first-class space specialists are working on the Zerkalo now. That we have provided work for whole divisions of many Russian aerospace firms. And for a good many years. That we are applying and bringing to life the most advanced technologies.

MARKOV: When, then, can we expect the launch of the first Zerkalo satellite system?

MOROZOV: In mid-1995.

There wasn't enough time to continue the conversation: that day, at the invitation of the Massachusetts Institute of Technology, Nikolay Morozov flew to Cambridge (U.S.) for the First International Congress on Telecommunications.

Simulation of Observations by 'Ikar-1' Microwave Radiometer System Using Remote and Contact Shipboard Measurements

927Q0243A Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 92 (manuscript received 25 Nov 91) pp 22-31

[Article by L. M. Mitnik, M. L. Mitnik and M. Yu. Shum, Pacific Ocean Oceanological Institute, Far Eastern Department, Russian Academy of Sciences, Vladivostok; UDC 528.831.1]

[Abstract] The method used and the results of numerical simulation of microwave-radiometric sounding of the ocean-atmosphere system using the "Ikar-1" system ("Priroda" project) are discussed. The simulation was carried out using shipboard aerological data and microwave radiometer measurements of the cloudy atmosphere. The examples of sounding of a thick cumulonimbus cloud and a cold atmospheric front are used in evaluating the influence of the directional diagram of the antenna and the integrating circuit in the microwave radiometer on the measurement results. A method is proposed for constructing the vertical profile of cloud liquid-water content on the basis of single-channel (wavelength 2.3 cm) measurements from a research ship. This made it possible to compute variations in the brightness temperatures of the ocean-atmosphere system and to evaluate the antenna smoothing effects for them. It was found that variations of antenna temperatures and their differences from the brightness temperatures are essentially dependent on the form of the directional diagram, especially on the width of its main lobe; the influence of the integrating circuit is far less. Solution of the direct problem (simulation of MW measurements from space) is a necessary stage in developing methods for solving the inverse problem (retrieval of geophysical parameters from sounding data). Figures 4; references 19: 11 Russian, 8 Western.

Experience in Using 'Trasser' Instrument for Observing Ocean From Space

927Q0243B Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 92 (manuscript received 17 Feb 92) pp 32-39

[Article by S. N. Korolev, A. A. Kucheryavyy, V. A. Mironenko and V. S. Suyetin; Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 551.46.08]

[Abstract] The results of processing of remote spectrometric measurements of brightness of the ocean-atmosphere system using the "Trasser" instrument aboard the Okean satellite are presented. The information yield from this instrument is evaluated and a simple method for the atmospheric correction of measurements is proposed. The file used for these purposes consisted of 138 measurements more or less uniformly distributed over the North Atlantic in the latitude range 0- 50°N for the period January-October 1989. Only measurements made with a solar altitude > 30° were included in order to attenuate multiple scattering effects. Solar altitude varied from 30 to 88° and solar azimuth from -140 to -15 and from 32 to 170°. The scattering angle was from 91 to 172°. These materials were used in constructing a map of the spectral brightness coefficient of the water in the blue spectral region. This map is reproduced in the article. The procedures used in its preparation are discussed and the significance of the plotted differences is analyzed. The atmospheric correction algorithm used is described. Only qualitative conclusions are drawn because there are no reliable control data on optical parameters of the ocean at subsatellite points. Figures 3; references 12: 7 Russian, 5 Western.

Use of Spline Approximation for Synthesis of Fields of Earth's Geophysical Parameters From Satellite Microwave Radiometer Multichannel Measurements

927Q0243C Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 92 (manuscript received 25 Nov 91) pp 40-47

[Article by Ye. N. Lobanova and M. T. Smirnov, Radio Engineering and Electronics Institute, Russian Academy of Sciences, Moscow; UDC 551.46.08]

[Abstract] A method is described for using a spline approximation for a simultaneous retrieval of the geophysical parameters of the ocean-atmosphere system and synthesis of their two-dimensional fields on the basis of the results of multichannel microwave radiometer satellite measurements. The newly proposed approach involves solution of the inverse problem by use of a spline approximation with emphasis on the possibility of taking into account the spatial interrelationship of the parameters to be determined on the basis of a priori data on the relation of the scales of spatial variability (smoothness) of the retrieved fields. The method is applied to measurements made along satellite trajectories. The possibilities of the method and its errors are evaluated in the example of the model problem of retrieving the fields of integral moisture content in the atmosphere and the water reserve in clouds above the ocean using measurements at the two wavelengths 0.8 and 1.35 cm. The error in

synthesis is 2-3 percent for the moisture content field and from 5 to 13 percent for the cloud moisture content field, depending on the level of measurement errors. The simultaneous determination and synthesis of the fields of several geophysical parameters by the described method has a number of advantages over their independent determination and subsequent synthesis. Figures 5; references 13: 11 Russian, 2 Western.

Nonlinear Filtering of Complex Significant Codes for Outlines of Discriminated Features

927Q0243D Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 92 (manuscript received 29 Jan 92) pp 48-52

[Article by V. V. Yanshin; Computer Science Institute, Russian Academy of Sciences, Moscow; UDC 391.621.25]

[Abstract] a new method is proposed for filtering complex significant codes for the outlines of discriminated features. The method is based on a nonlinear rule of formation of the filter output using data for a limited number of elements of a complex significant code at the filter input. The described method for the nonlinear filtering of features (complex significant codes and their real and imaginary components) makes it possible to filter out different distortions of the outlines of discriminated features and the resulting mathematical models (in the form of finite regular Markov chains) make possible theoretical computation of the probability of distortions of outline indicators. The method was used in processing images obtained using a thermal imagery unit. Since the outline coding is accomplished using the V. V. Yanshin algorithm, published earlier, the nonlinear filtering of outlines was accomplished in the scene formation process. The sole algorithm parameter open for choice is aperture dimension m. Its choice is formalized with difficulty. The fact is that the "dimension" of the noise cluttering the outline is dependent on its frequency spectrum and the frequency properties of such noise have not yet been fully studied. Recommendations are given on choice of the m quantity so that all noise of a lesser "dimension" is filtered out, whereas noise of a greater "dimension" is discriminated. References: 6 Russian.

Ecological Situation and Organization of Global Ecological Space Monitoring System

927Q0243E Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 92 (manuscript received 23 Apr 92) pp 57-65

[Article by G. I. Belchanskiy, Institute of Evolutionary Morphology and Animal Ecology imeni A. N. Severtsov, Russian Academy of Sciences, Moscow; UDC 629.7:525]

[Abstract] The concepts involved in establishing a global ecological space monitoring system, the direction of development and improvement in the organization of research and development work in different countries and the increase in the economic efficiency of space vehicles within the framework of the developing ecological situation throughout the world and in Russia and the other commonwealth countries are reviewed. In Russia and the CIS states, despite adequately great state expenditures and the large number of groups dedicated to ecological objectives and the considerable time which has elapsed since the onset of such work, the principal objectives have not been attained. No sufficiently large centers have been established for accumulating and processing data and this has resulted in the loss of enormous masses of important data collected from space during many years of active operation of different observation systems. Exceedingly difficult conditions have evolved for developing adequate models for evaluating and predicting natural and anthropogenic changes in the environment, biological systems, etc. The reason for the stagnation which has developed is probably attributable to the erroneousness of the initial concepts, the breakdown of the problem among a great number of ministries and departments, the dissipation of state funds and the lack of effective coordination of the work. The picture has been clouded by the dearth of funds now available for any space research, despite all the arguments which have been set forth with respect to the need for funding ecological research based on observations from spacecraft and the faith among its proponents that great economic returns will be realized from such work. References 18: 13 Russian, 5 Western.

Use of Satellite Optical Information in Studying Baltic Sea Coastal Regions

927Q0243F Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 92 (manuscript received 5 Nov 91) pp 75-81

[Article by V. Yu. Lobanov, St. Petersburg Division, State Oceanographic Institute; UDC 578.873.551.46]

[Abstract] Examples of interpretation of satellite photographs taken in the visible and near-IR ranges over the surface area of the Baltic Sea are presented. Analysis of a number of Baltic Sea surveys using satellite instrumentation revealed that the nature of the registered optical inhomogeneities, especially for space images of a high spatial resolution, is dependent on the hydrographic conditions in the survey region. The diffuse radiation scattered by the bottom may play a role for sandy-oozy shallow waters, which makes it possible to observe different forms (accumulative) of bottom relief. Multichannel space information makes it possible to investigate the structure of lagoons, location of underwater channels, elements of bottom relief forming under the influence of river runoff and wave-surf activity and the structure of shoals. Repeated surveys of such sea regions make it possible, particularly in combination with reference observations, to monitor the movement of bottom sediments effectively. Optical inhomogeneities of skerry coasts give an image of suspensions of mineral origin propagating into the sea from rivermouth regions. Intramass suspended matter, for the most part of mineral origin, has a predominant role in the formation of optical inhomogeneities on photographs of the mouths of the Neva, Nyamunas and Pyarnu Rivers, situated outside skerry regions. In this case, however, it is necessary to take into account the possibility of the appearance of individual bottom sectors on the image, especially due to sea level variation. Figures 5, references: 7 Russian.

Relief and Land Use Structure in Central Afghanistan Determined From Space Survey Data

927Q0243G Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 92 (manuscript received 24 Feb 92) pp 93-102

[Article by Yu. L. Obyedkov and M. N. Zurmati, Water Problems Institute, Russian Academy of Sciences, Moscow. UDC 528.7:91++551.162+551.482.6]

[Abstract] Space photography was used in studying relief and land use structure in Central Afghanistan. The initial materials were data from a space survey collected during the Soviet-Afghan flight in the Mir orbital station in August-September 1988. The research was centered on the Kabul structural block and its mountainous margins, within whose limits at the regional level it is possible to trace regularities in the distribution of rocks of the unconsolidated sedimentary mantle, conditions of formation and spatial distribution of surface and subsurface runoff, positioning and subordination of different morphological and structural elements. A geomorphological map of relief types was constructed and is reproduced in the article. Four relief categories are discriminated: 1) denudational-tectonic, including all classes of mountains; 2) denudational with hilly and hilly plain landscapes; 3) accumulative with plains of inter- and intramontane depressions; 4) erosional-accumulative with landscapes of sloping piedmont plains, river valleys and lakelike depressions (within each of the relief types rather reliably interpreted morphogenetic types are defined). Multiband black-and-white, false color and synthesized space images, aerial photographs and surface observations in key sectors were used in determining the structure of land use and affinity of different types of land use to various relief elements. The results are outlined. The regular collection of such space survey materials with the simultaneous systematization of surface observations will make it possible to monitor the structure of land use and thereafter predict its changes. Figures 2; references: 7 Russian.

Earth Observation System (EOS). Ecological Priorities and Planning of Observations. 2. Instrumentation

927Q0243H Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 4, Jul-Aug 92 (manuscript received 14 Jan 92) pp 110-122

[Article by K. Ya. Kondratyev; UDC 629.78:551.46.0]

[Abstract] The ensemble of scientific instrumentation developed for the EOS program for global ecological monitoring (atmosphere-hydrosphere-cryosphere-biosphere), planned to extend over a 15-year period, is described and the stages in implementation of observations with this system are outlined (the supporting EOSDIS system also is discussed where pertinent, as are the satellites which carry or will carry the indicated instruments). The new scientific priorities formulated as a result of budgetary restrictions are outlined. Among the new instruments described are the following: high-resolution videospectrometer, multichannel scanning radiometer-videospectrometer, multiangle videospectrometer-radiometer, satellite lidars, multifrequency microwave radiometer, scanning microwave radiometer, microwave instrumentation for determining soil moisture content, radar with synthesized aperture, instruments for measuring Earth's radiation budget, scanning polarimeter, high-resolution limb sounder, limb spectrometer and lightning monitor. The mentioned priorities include research in the following fields (which are briefly discussed): water and energy cycles, oceans, chemistry of troposphere and lower stratosphere, land surface processes and dynamics of ecosystems, glaciers and polar ice caps and Earth's crust. Some of this information is summarized in a series of five tables. References 16: 4 Russian, 12 Western.

Features of the Measurement of Surface Wind by Space-Based Scatterometers in a Mixed Sea State

937Q0053 Moscow ISSLEDOVANIYE ZEMLI in Russian No 5, Sep-Oct 92 [manuscript submitted 22 Oct 91] pp 3-12

[Article by A. A. Zagorodnikov, Experimental Design Bureau INFORM, Simferopol State University imeni M. V. Frunze; UDC 528.8.044.4]

[Abstract] The principal spaceborne remote-sensing detector for wind over the surface of water is the scatterometer. The theory underlying scatterometry assumes a uniformity of wind-driven sea state, whereas there is usually a system of swells (or several) involved. The researchers analyze the sources of errors found in scatterometric measurements of the characteristics of surface wind in a mixed sea state. They note that the measurement of the velocity modulus of the surface wind is based on the effect of linking its current value with the spectral density of light swells. The spectral density determines the magnitude of the specific effective scatter area of the agitated water surface. That scatter area is a function of the angle at which the sea surface is shot. The inclinations of the large gravity waves on whose slopes there are capillary-gravity ripples produces variations in the local angles of incidence at which the elements of the water surface are observed. The leeward wave slopes have the greatest average steepness, the windward slopes have a lesser steepness, and the slopes that are perpendicular to the primary run of the waves have the smallest average steepness. The nonlinear interaction between swell and wind-driven sea state was not taken into consideration here. Nonlinear interaction is important when the angle between wind direction and swell direction is less then 30° and when there is an overlap of energy-bearing frequencies of the spectrum. Transfer of energy from the swell to the wind-driven sea leads to an increase in the steepness of the wind waves and, consequently, to measures values of surface wind velocity that are too high. Error in the measurement of surface wind parameters is twice as high as allowable. The accuracy of scatterometric measurements can be raised if data on the structure of the mixed sea are received at the same time. Figures 6, references 11: 6 Russian, 5 Western.

Details of Russian Civil Space Program 1993 Budget

93?Q0086 Moscow IZVESTIYA in Russian 13 Feb 93 p 15

[Article by Sergey Leskov, under the rubric "Science, Technology, and Medicine": "The Russian Space Program Changes Orbit and Goes After Problems on the Ground"; first paragraph is source introduction]

[Text] **The Russian Space Agency has published a draft of the "State Space Program Leading Up to the Year 2000," which revises the priorities of one of the leading, science-intensive sectors in a number of fundamental positions.**

In the happy, more generous years of stagnation, the space program was the object of official pride in the socialist system. The sector was inaccessible to the free exchange of opinions, as a result of which, in the late 1980s, it was transformed from everyone's favorite into the object of criticism that wasn't always objective. But the reality is such that today, not a single large economic problem can be solved without the services of the space sector. Which is why, with the impoverishment of the treasury, the problems of the space program consist not so much in the financial constraints, but in the redistribution of its customary priorities.

The state program presented by the Russian Space Agency [RSA] was put together by specialists of the leading space enterprises and is supported by the committees of the Supreme Soviet of Russia and by the ministries of economics and finance. In the opinion of RSA General Director Yuriy Koptev, the draft will be approved by the Supreme Soviet and the amendments maybe quite minor.

The total civil space budget is set at R51 billion in terms of prices that were in effect at the end of 1992, which, based on indexing, is roughly twice as low as the sector's budget in the early 1980s. Yu. Koptev stressed that today, the material difficulties the space sector is going through are forcing it to focus not on its own interests, but on the needs of consumers in terms of the results of space activity.

For that reason, the development of satellite communications has, for the first time ever, been moved to the No 1 spot in the state program. In addition, six other main areas have been singled out: monitoring of the Earth's surface, inspection of space for scientific and military purposes, improvement of launch systems, development of ground-based infrastructure, creation of reusable transport systems, and performance of long-term research.

In early 1993, a total of 22 Russian satellites were being used for communications. It is expected that the number of main-trunk communications links will triple by as early as 1995 and will be several tenfold larger by the year 2000. In that context, it is the communication satellites that represent for the space program a promising source of revenues gained from services proffered to other states and to commercial enterprises. Today, in fact, not one of the states of the former USSR that are making use of communications satellites has contributed a copeck for the maintenance of those satellites, and Russia is carrying 98 percent of all space spending. Not even the four agreements signed by the heads of state of the CIS on that score are helping things. In Yu Koptev's words, that problem must be resolved at the next intergovernmental meeting in February.

The R51 billion named in the budget represents 0.22-0.27 percent of the expenditure schedule of the 1993 federal budget. By comparison, that figure in the United States for the current fiscal year is 0.95 percent. Specialists feel that the mandatorily reduced hunger rations on which a sector based in the leading technologies has been placed threatens to put the country behind in many high-priority areas. World experts today list 21 "crucial" technologies, and 16 of them are used in rocket hardware. Russia leads the world in only two of them—powerful liquid-fuel motors and medical aspects of long-duration manned missions. We are farthest behind in electronics, which is particularly sad in view of the plans for the development of communications satellites.

Our lost ground in rocket technologies has not yet become irreversible. But we can't wait any longer to correct the situation, and this year already, nearly 10 percent of the space budget is being set aside for the development of technologies and elements that have been called upon to provide the Russian space program the leading position in the beginning of the 21st century. In that context, spending continues to be cut for reusable systems, primarily from which the money for communications systems has been borrowed. Only 1.8 billion were released for the long-suffering Buran, which will barely be enough to just keep the unique complex "afloat."

The named figures are arbitrary. And not just because the approved program still doesn't guarantee actual financing. An extremely unsteady boundary separates civil space and military space, and one satellite may serve two departments. In such a situation, of course, broad possibilities open up for maneuvering with the articles of the space budget, and assurances that less money will be released for military space in 1993 than for civilian space arouses some mistrust. And the uncertainty becomes even stronger as a result of the fact that because of the overall cutback in military spending, the operation of several large space facilities is expected to be transferred in the near future to the civilian department.

Even a partial solution of the problem of the recoverability of space expenditures could attenuate considerably the tension surrounding a sector that requires fairly large budgetary outlays. But on the world space-services market today, Russia accounts for not even one-half of one percent. Ten years ago, the situation for gaining solid footholds on the world market was favorable, but economic interests in the USSR at that time trailed political ambitions. Today, the space market is divided up, and our competitors, amid tender exhortations that they support our reforms, are doing everything they can to keep Russia from being admitted into the market.

And yet, Russia still has opportunities to break into the world space-services market, and they are in Russia's most efficient sector—that of the launching of satellites of various kinds. In the world today, 22 satellites a year are launched, and if Russia gets the opportunity to launch just three foreign vehicles into orbit, that will give the sector nearly $200 million, which would guarantee it a fairly comfortable

Space program spending of the Russian Federation (RSA), the United States (NASA), and the European Space Agency (ESA).

Key: 1. Billions, in dollars—2. NASA (U.S.)—3. ESA—4. RSA (RF)

existence. RSA General Director Yu. Koptev views the problem optimistically and feels that the issue will be resolved in the next six months. But for now we have to be happy with the not-particularly-profitable missions involving foreign cosmonauts. Today, Russia has about 10 such requests. When you consider that we are planning two or three launches a year, the payments for the missions won't begin to make their way into the treasury that soon.

Comparison of federal-space-program appropriations requested in Russia (RSA) and the United States (NASA) for 1993 in terms of space hardware with scientific and economic missions (based on the ruble exchange rate of 8 February 1993)

	RSA		NASA	
Areas of hardware and type of operation	**Millions of dollars**	**Percentage**	**Millions of dollars**	**Percentage**
1. Satellite communications, broadcasting, and navigation	7.12	7.9	149.9	1.0
2. Remote sensing of the Earth	11.40	12.7	1199.4	8.0
3. Space technology	1.05	1.2	30.0	0.2
4. Manned complexes and international cooperation based on them	14.88	16.5	2249.0	15.0
5. Systems for launching spacecraft	11.61	12.9	1079.5	7.2
6. Scientific space complexes	13.70	15.2	1994.0	13.3
7. Maintenance and development of unique ground experimental base for perfecting space hardware	5.77	6.4	No data	No data
8. Ground-based computerized complex for controlling space vehicles	4.33	4.8	944.5	6.3
9. New materials, technologies, and equipment for developing rocket-space hardware	2.70	3.0	329.8	2.2
10. Reusable space transport systems (including spaceplanes)	6.96	7.7	5022.7	33.5
11. Space launch facilities	10.44	11.6	1994.1	13.3
12. Undisclosed operations	89.97	100	14,993.0	100.0
In additional volume of capital investment	3.06	-	-	-

Space Program

937Q0078A Moscow TRUD in Russian 6 Feb 93 pp 1, 5

[Interview with Yuriy Koptev, general director of the Russian Space Agency, by TRUD political observer Vitaliy Golovachev; place and date not given: "Money—in Space and From Space: Russia Is Trying To Find a Place in the World Market for Rocket Technology"]

[Text] **"Russia is trying to enter the world market for space technology in order to become a serious competitor...." "Moscow has offered the Republic of South Africa SS-20 rockets to launch nine satellites from Russian mobile launchers that will be delivered to South Africa. Instead of $40 million at Western prices, Russia is prepared to take only $10 million for each launch...." "The American company Pratt and Whitney has concluded an agreement in Washington that will give Russian experts an opportunity to sell rocket engines developed by the Energomash Scientific-Production Association profitably in the United States...."**

These are just extracts from a flow of similar reports that are appearing with increasing frequency in the world press. Meanwhile, at hearings of the Russian parliament the general director of the Russian Space Agency [RKA], Yuriy Koptev, stated in November last year that "the space complex is on the brink of crisis." So what is the situation in reality?

This is how I started my interview with Yuriy Koptev.

The truth is that the situation in our complex, and throughout the industry, is extremely complicated, the leader of the space agency said. Over the past two or three years we have lost one-third of our highly skilled personnel. You know, any world class expert will say that this is a critical factor for the survival of the sector. Last year alone more than 30,000 people quit the industrial enterprises of space complex or were let go in connection with the production cutback, and 40,000 left scientific institutions.

And it is no wonder that they are leaving. The average wage at the Energiya Scientific-Production Association, for example, was 503 rubles [R] in 1991, and last year it was R4,043; it is about R3,000 at the Voronezh Design Bureau, and R2,941 at the Izmeritelnaya Tekhnika Scientific-Production Association... It is the astonishing loyalty of many workers in the sector that is saving it from total collapse. Nevertheless, the loss of one-third of the scientific and production elite is a serious symptom.

[Golovachev] But perhaps Russia does not need a space rocket complex on its previous scale?

[Koptev] It is no longer a question of anything on that scale. But it is essential to understand the main thing. Without a modern scientific industrial sector Russia would become quite a different country. Communications, television, weather forecasting, the study of oil and gas and other natural resources—can you imagine the country without these? I do not even mention that realization of our new military doctrine (mobile troops, highly accurate weapons, dynamic control, detection of early signs of preparation for war in other states) would be quite impossible. So it is a question of the country's vitally important interests. It is precisely on these state targets that budget allocations should be directed today. Which, of course, does not exclude the possibility of developing and realizing many other space projects on a commercial basis.

Nowhere in the world—not in the United States, not in the European countries, not in Japan—is the space complex self-sustaining financially, and most of the funding comes out of the budget (80-85 percent). In the United States it is $35 billion a year, in the European Space Agency 3 billion, in France 2 ...

[Golovachev] And in Russia?

[Koptev] According to our calculations this year we will need R48-50 billion (in 1993 prices) from the state budget. In addition, off-budget funds will be attracted: that is client's money: the Ministry of Communications, commercial structures, and others. However, all the funds that we expect to receive from commercial agreements from Russian and foreign clients will make up less than 20 percent of our budget. Let me say it again. In no country does space research exist on a self-sustaining financial basis.

[Golovachev] Could you give some examples of commercial cooperation?

[Koptev] The possibility is now being studied of Russia's participation in large-scale projects with the European Space Agency (ESA). Preliminary agreement was reached late last year in Granada (Spain) at a meeting of ministers from the 13 ESA member countries. It was a question of our participation in the Columbus European orbital station and the Hermes space airplane (this is where the experience gained in developing the Buran vehicle is very useful), and also a joint program of manned missions.

In general the contract promises to be an extremely big one for Russian space research. The total, including costs for two flights by European astronauts, may reach about $[illegible] million before 1995. It is expected that the contract will be signed in February or March. But in order not to lose time the first group of ESA astronauts have already arrived at Zvezdnyy Gorodok—the Belgian Marianna Merches (she has two professions—pilot and medic), the Spanish engineer Pedro Dukke, and a Swedish scientist, Doctor of Physical-mathematical and Technical Sciences Krister Fuglesang.

[Golovachev] Is a Soyuz mission possible with a crew made up entirely of foreign astronauts, as the Western partners are suggesting?

[Koptev] I think that this question requires detailed discussion. In my opinion it is better to retain the present scheme whereby our cosmonaut pilots the vehicle as the crew captain.

If we continue our examples, then I would talk about the agreement with France on flights by four astronauts on Russian vehicles before the year 2000. The first flight will take place soon, in July. The French will be paying $[illegible] million for each mission.

A $36-million contract is being drawn up for the [illegible] launch of the first Western satellite of the INMARSAT international organization. Launch is planned for [illegible]

Just recently, a few days ago, an important agreement was discussed in Switzerland between the American Motorola Company and the Lockheed-Khrunichev joint-venture to use three Proton rockets to loft Iridium communications satellites into orbit. The contract is worth about $200 million...

At the same time I would like to note that Russia's entry into the space market for space launches is connected with overcoming existing political restrictions. What I have in mind is first and foremost the notorious Cocom [Coordinating Committee for Multilateral Export Controls] agreements. Until the discriminatory Cocom restrictions and other prohibitions from the time of confrontation in the cold war are lifted, it is impossible to talk about a world space market.

[Golovachev] It is, I think, also impossible to remain silent about the prospects for cooperation between the Russian and American space agencies...

[Koptev] The immediate prospects are known—in October our cosmonauts will be flying on the shuttle (Sergey Krikalev and Vladimir Titov are now training in the United States, but only one of them will go into space), and in late 1994 or early 1995 an American astronaut will fly on the Mir. He will go there aboard a Soyuz and return in the shuttle, which is to dock with the Mir in the spring of 1995....

But perhaps even more interesting and very promising both for us and for the United States, and in general for world space research, might be Russia's participation in the development of the enormous 100-meter American Freedom orbital station that will operate in space for 30 years. The plan is to have four hermetically sealed modules where the astronauts can live and work. The crew will be made up of up to eight people and the cost of development and assembly is more than $30 billion.

One acute problem facing the developers of the station today is space rescue vehicles that could be requested by astronauts in the event that the space home has to be abandoned because of an emergency. The vehicle should be docked with the station so that they could return to Earth at any moment. The reusable shuttle is not suited for this, first because it can stay only for a limited time in space (several weeks after each launch), and second, because it would be extremely expensive.

This means that the Americans must develop special rescue vehicles. This could be done, for example, by the Lockheed Company. But development of the vehicles will require at least a billion dollars and five or six years of work. Meanwhile, in Russia there are reliable reusable transport vehicles of the Soyuz series, which have given a very good account of themselves. They, of course, will also require some modernization, but the costs here are not to be compared with the cost of developing a new vehicle. The United States could make this version for three or four times less cost. We could sell the Americans several modernized Soyuz vehicles for use with the Freedom station. Such a contract would be worth several hundred million dollars and would be very attractive for Russia. The feasibility of realizing this project is now being studied in our two countries in accordance with the first contract concluded between NASA and the Energiya Scientific-Production Association.

[Golovachev] The launching of communications satellites is also very effective on the commercial plane. What positions does Russia have in the world market in this sphere?

[Koptev] First of all I would like to remind you of the first commercial project, which envisaged the development of a Russian-Canadian satellite meeting world standards. The SOVCANSTAR Russian-Canadian joint-venture enterprise was set up recently. Using our Proton rockets it is planned to launch five communications satellite each weighing 2.5 tonnes. After they have been placed in stationary orbit they will always be over the same point on Earth. It is a global commercial satellite system that will provide about 100,000 two-way telephone channels across the entire planet. Naturally, it will also be possible to feed television programs through these channels and organize telegraph and teletype communications and handle data transmission. Russia will use some of the channels and the rest will be offered in the international market.

The total investment is more than $200 million, and a decision for Canada to put up $90 million has already been made. The satellites will be fabricated jointly, at the Krasnoyarsk Scientific-Production Association of Applied Mechanics, and the repeater and antennas by the Canadian side. A start is to be made on the project late in 1995.

[Golovachev] Russia is being accused of dumping in the world space market. U.S. Vice President Albert Gore has demanded that an end be made to the policy of the "predatory" prices set by Russia and China for launches....

[Koptev] Well, let us take a look at the economic calculations. It costs $3,000-$4,000 to launch 1 kilogram of payload into low orbit using our Proton rocket; the figure is $2,000 for the Soyuz and $2,400 for the Molniya. On the American rockets this same payload costs five times more. Our rockets are more economical and, moreover, we have a different price structure. But despite all that, we are not trying to engage in dumping. In addition, some clients reproach us: Why, given such low prime cost, do we set relatively high prices in the world market. We usually answer: Well, we buy wheat from you at world prices. ..

[Golovachev] Does this mean that you are prepared to trade in the space market at average world prices?

[Koptev] Of course, this is also in our interests. But we need to determine what the world price is. For use of their Ariane rocket the French charge $70 million, the Americans charge $56 million for their Atlas, the Chinese about $30 million ...Where do we make the comparison? There must be some difference in price otherwise competition is impossible...

[Golovachev] What are Russia's hard currency "earnings" from commercial space projects?

[Koptev] In the immediate future I think it will be something on the order of $200-300 million a year.

[Golovachev] Will modified military rockets that should be destroyed under the terms of the disarmament treaties be used for commercial launches?

[Koptev] The first what we might call demonstration launch of an SS-25 rocket modified to launch commercial satellites will be launched in February. These rockets can loft small satellites weighing up to 550 kg into orbit. Other rockets are able to loft heavier payloads into orbit: the SS-18, 4.5 tonnes, and the SS-24, 2.5 tonnes. In all about 2,000 various types of our military rockets will become available. Of course, it would be a good thing to use them for peaceful purposes—to launch communications satellites and other kinds of satellites. But I am not sure that we will find many customers. Although some inquiries are being made. It is an important problem and it must be seriously addressed. It is not so difficult to destroy them, but the task is to make some profit even in this complicated situation.

We have recently already destroyed about 800 medium-range and short-range missiles. The Americans cut them into pieces and we blew them up.... Just the metal alone is of some worth! If we approached this problem sensibly we could make a little profit. It is somehow senseless....

In general many ill-considered decisions are being reached. For example, our

Main Points of Draft Plan of Russian Space Program to Year 2000

937Q0018 Moscow KOMMERSANT-DAILY in Russian No 1, 6 Oct 92 p 4

[Article with no byline: "From Three Sources—Four Aims"; first paragraph is source introduction]

[Text] **The Russian Space Agency (RSA) has developed a draft of the first State Space Program for Russia to the year 2000. The draft has already been coordinated in the interested ministries and will soon be officially sent to the Supreme Soviet of Russia. Experts feel that, in addition to formulating the science and technical goals of Russia in space, the program has yet another important aim: to ensure the stable budgetary financing of enterprises of the enterprises of the aerospace complex.**

Experts feel that the text of the draft defines in a methodologically correct fashion three sources, seven main areas, and four chief goals of space-sector activity. Chosen as the sources of program financing are, of course, the state budget of the Russian Federation, the state budget of the countries of the CIS, and the state budgets of foreign countries.

The seven main areas of operations are the following:

- the creation of space-based communications hardware and systems, plus satellites for direct television broadcasting
- the development of systems for observing the Earth, including dual-purpose systems (military and civilian)
- space research and interplanetary flights
- the improvement of launch systems (standardization, and reduction of toxicity)
- manned flights (the launch of the Mir-2 station)
- basic and applied research

The four chief goals of the space program consist of the following: support of defense capabilities (including the development of monitoring systems); use of space hardware in the national economy; solution of fundamental problems; and international cooperation.

Experts feel that a serious struggle will take place around this seemingly boring document: first, the RSA will not know how to "fairly" divide the budgetary financing among the sector enterprises; second, there are, in the Supreme Soviet of Russia, those who want to reduce spending on space.

Telephone RSA: (095) 251-43-42

Financing of Russian Space Program Under Discussion

937Q0066 Moscow KOMMERSANT-DAILY in Russian 14 Dec 92 p 4

[Article by Dmitriy Kamin, under the rubric "Draft Decree of the Supreme Soviet of Russia on Space": "Space Is Not Being Written Into the New Budget"; first paragraph is source introduction]

[Text] **Yesterday, the Commission for Transportation, Information Science, Communications, and Space presented for the perusal of the presidium of the Russian Supreme Soviet drafts of a Supreme Soviet decree and declaration in which measures are suggested for stabilizing the situation in the space sector and in which the priorities of Russian space policy are determined.**

The growth of the space program requires special economic approaches and financial decisions, the absence of which today some specialists estimate to result in $1 billion lost by Russia annually in just the brain drain abroad from this sphere. Members of the parliamentary commission tend to blame the executive authorities for that, because they, in the opinion of the commission, give preference to military projects, which hinders the development of commercial projects and limits the influx of monies to the space program. In 1992, spending on defense-related space projects was increased 10-fold over spending in 1991, whereas money allotted for other programs grew by only 4.5-fold. In that context, says the commission's chief specialist, Vladimir Postyshev, the state often does not pay for its space orders filled by the sector. That forces the scientists to take out commercial loans to execute government projects. In Postyshev's opinion, the versions proposed by the commission—including the solution of problems like the development of information networks and communications and the creation of other profitmaking programs—will help correct the situation in the space program. In a conversation with this newspaper's correspondent, Postyshev reported that the state space program has not yet been developed, even though the fiscal year is coming to an end, and that it is time to plan spending for the future. He also noted that

the sector will hardly receive the 8.7 billion rubles promised by the budget for this year and that in the draft budget for 1993, no spending for space projects is not even called for.

The draft documents, after being examined at the presidium, were sent to committees and parliamentary commissions for study. In 10 days, the Russian Supreme Soviet must adopt a resolution regarding the proposed projects, about which this newspaper will report after the Christmas holidays in the 5 January issue.

Political, Economic Woes of Baykonur

MK0902131993 Moscow NEZAVISIMAYA GAZETA in Russian 9 Feb 93 p 6

[Anatoliy Zak report: "Cloudy Winter in Baykonur. Russian Space Rocket Test Site Facing Problems on Earth and in Space"]

[Text] While final preparations were under way at the Baykonur cosmodrome for the launch of the spaceship Soyuz TM-16, other events equally important to the future of Russia's space industry were also happening at the country's main space port. During these days representatives of the topmost echelon of our space program came here to see with their own eyes the present-day state of Russia's rocket site on Kazakhstan's territory. The specialists were accompanied by a large group of people's deputies, including Aleksey Adrov, chairman of the Soviet of the Republic Commission for Transportation, Communications, Information Science, and Space.

This trip gave Russia's legislators an opportunity to meet with representatives of Kazakhstan to attempt to remove the uncertainty over the cosmodrome's status in relations between two CIS members. The main problem is still the failure to implement interstate agreements on Baykonur which were concluded on 25 May last year with the intention of settling the sides' mutual claims. Now, in the view of cosmodrome chief A. Shumilin, a special mechanism needs to be created, capable of putting the earlier agreements into effect.

Probably the main cause of disagreement is the extent of the sides' financial participation in maintaining the site. According to the Russian side's figures, Kazakhstan's present contribution accounts for 6 percent of a total sum of 28 billion rubles [R] allocated to Baykonur. "And they're my bosses," one of the Russian deputies protested on this score. For their part, Kazakh officials say that apart from the purely financial contribution, Russia should bear in mind the huge areas of land removed from the republic's sphere of agricultural production.

Another important problem is the Kazakh leadership's claims relating to control of the cosmodrome's infrastructure and military units, and the questions that arise in this context among the officers, most of whom consider themselves citizens of Russia. Even now, on the streets of Leninsk (as the residential zone of the cosmodrome is called) in the evenings you can see the dark windows of many empty apartments. While the cosmodrome's important guests were giving a press conference for journalists, a group of young officers gathered at the entrance to the Cultural Center, where the meeting was taking place, to demand immediate discharge from the army. The difficult living conditions at the site are not the only reason for this; there is also the uncertainty over its political future. To be fair, it should be said that many representatives of the cosmodrome acknowledge that the president of Kazakhstan is showing great tact and restraint.

One way or another, it is clear that the cosmodrome's future will depend on the financing of the space program in Russia. This year R34.5 billion has been allocated for space research, covered by a single line in the Russian state budget. Now the Adrov group's aim is to secure the Supreme Soviet's adoption of a space budget where the total sum will be distributed to specific programs.

The seething political passions are nonetheless not stopping the intensive work at the cosmodrome's launch sites. Last year 23 satellites out of the 48 launched by Russia were put into orbit from Baykonur. In the same year the United States, Europe, China, Japan, and India between them sent only 39 devices into space. The current year also promises to be busy. Recently, after a series of failures, launches of the sophisticated Zenit booster rocket were resumed. Despite problems with the financing of this program and the unusable condition of one of the launch pads following the 1991 disaster, this year three or four new Zenit launches are expected.

Conversion processes have led to a completely new phenomenon at Baykonur. Preparations are currently in progress for the February launch of a modified SS-25 ICBM which, instead of nuclear warheads, will be carrying a small commercial satellite destined for use in an electronic mail system. Launches of this kind promise to make money.

At the same time, for several years now silence has reigned over the giant launch installations used by the Energiya-Buran system. Energiya Science-and-Production Association General Designer Yu.P. Semenov, who also visited the cosmodrome at that time, rejected the idea of mothballing the complex. In his words, barring major upheavals like the complete closure of the Baykonur cosmodrome, the Buran space plane is scheduled to be prepared for its second test flight within about a year. Yu.P. Semenov stressed that his objectives include perfecting the Buran-Mir docking operation before the American Space Shuttle visits the Russian orbital complex in approximately May 1995. But many specialists here seem not to share this optimistic view. "Surely it's now clear it will never fly?" was one cosmodrome engineer's gloomy answer to a question about the prospects for a Buran flight. According to cosmodrome employees, repair and restoration work on the Buran launch complex alone will take a year. This is largely the result of the systematic pilfering of equipment from unguarded launch pads. "Everything that can be stolen, has been stolen," a launch complex expert states. In his words, components made out of copper and other metals are misappropriated by the kilogram daily.

The Energiya-Buran launch complex includes two launch pads, of which only the "left launcher" has been used to

launch Buran, while the "right launcher" has been mothballed in an incomplete state. There is also a test bed from which it is possible to launch Energiya rockets without Buran. There is also a landing strip designed to take a shuttle craft, but experts claim that it no longer has the capability for an automatic landing by an unmanned space plane, as was brilliantly executed in 1988.

Comments at Supreme Soviet Hearings on Space Program

937Q0051 Moscow KOMMERSANT DAILY in Russian 11 Nov 92 p 2

[Article by Alla Fedorchuk, under the rubric "The Supreme Soviet Discusses Space Issues": "Russia Will Be Able to Earn Money With International Launches"; first paragraph is source introduction]

[Text] **Parliamentary hearings took place yesterday, and their purpose was to develop measures to alleviate the effects of the economic crisis that space science and industry are going through.**

This summer, legislators won a victory in that they finally got the financing of the space program written into the budget as a separate line, as is the custom in the rest of the world. But the space sector continues to be financed on a quarter-by-quarter basis, in the context of the so-called residual principle.

That fact was stressed in the address given by the director of the Russian Space Agency, Yuriy Koptev, who reported that his department has prepared a state space program that goes up to the year 2000 and enables us to avoid confining ourselves to the coming months, but rather to see the more long-term prospects. He also noted that the financing of research to the tune of 2.8 percent is totally unacceptable, because that will reduce Russia in the next five years to the level of an underdeveloped state. In Koptev's view, at least 10 percent of the budget should be appropriated for such purposes.

In touching on the position of the Russian space sector in the world market, Koptev termed a success the fact that on 6 November the international organization Inmarsat had decided to use in its operations the Russian Proton rocket, which had competed against the French Ariane rocket. Overall, the agency director said, Russia in the next few years can count on two or three international launches a year, which will bring Russia $120-150 million a year. Koptev also emphasized Europe's interest in collaborating with Russia for the purpose of creating a counterweight to U.S. space expansion.

Speaking after Koptev, Valentin Stepanov, the director of the department of the defense sectors of industry of the former Ministry of Industry, reported to those present that the aerospace industry is undergoing a "devastating" 50-percent conversion. But despite the difficulties, there is hope that in the coming year, the volume of consumer goods will be comparable to the level of the past year, which is seen as a grand achievement. Stepanov also said that the sector's conversion program is costing 15 billion rubles, with all the money gotten exclusively in commercial banks.

Maj-Gen Yuriy Gusev, the deputy chief of the directorate of space systems of the Russian Ministry of Defense, did not agree with the legislators when they said that, as before, the sector is listing toward military programs. As proof, he cited the following figures. Russian hardware in orbit consists of 189 vehicles, of which 108 are military and dual-mission; whereas the United States and other countries have 192 vehicles in orbit, of which 126 are military.

Observers note that the hearings that took place are the first open hearings in the history of the Soviet space program. "Taped" for the first time were a number of valuable proposals, many of which were voiced by Vladimir Postyshev, the chief specialist of the parliamentary commission on transportation, communications, computer technology, and space. Specifically, he proposed that the right of intellectual property be immediately extended to developments of space hardware and technology.

Koptev Claims Russian Space Sector on Verge of Crisis

937Q0041A Moscow RABOCHAYA TRIBUNA in Russian 13 Nov 92 p 2

[Unsigned article: "They Are Robbing Us! On a Space Scale"]

[Text] The annual loss to Russia due to the leakage of information and sale of technologies, constituting our intellectual property, is about 1 billion rubles in the space field alone. This was announced in the Russian White House in parliamentary hearings on Russian space policy.

In the words of Yuriy Koptev, general director of the Russian Space Agency, the space system is on the verge of a crisis. A third of the highly professional personnel, a figure critical for survival of the branch, has been lost. The volume of scientific research work has been reduced to 2.8 percent. Of the 25 launchings planned for this year in the interests of the economy only 14 have been carried out, and of the 70 planned military launchings—only 27.

Flight Testing of 'Buran-2' Reported Cancelled

937Q0041B Moscow KRASNAYA ZVEZDA in Russian 19 Nov 92 p 4

[Article by Valeriy Baberdin: "Energiya-Buran: What Are the Prospects?"

[Text] Reader O. Paneratov, writing from Penza, asks: "What is now going on with the Energiya-Buran space system?"

Colonel Valeriy Baberdin, cosmonaut-researcher, editor of the section on science, technology and cosmonautics of the newspaper KRASNAYA ZVEZDA, answers.

"We recall that the Energiya booster is multipurpose. It is capable of putting vehicles into circumterrestrial and lunar orbits and launching a very wide range of payloads onto interplanetary trajectories. There is no doubt but that this class of rockets will continue to develop.

"Now, with respect to the Buran spaceship. The similar, second copy of the Buran, is in the assembly-test structure at the Baykonur cosmodrome and will not soon be put into

orbit. Its flight tests have been cancelled. The reasons are all the same: there is no money for completing the costly project. But nevertheless we have not given up for good on the idea of creating space transport systems designed for repeated use. As recently stated by Yuriy Koptev, director of the Russian Space Agency, after the year 2000 Russia will proceed to the establishment of its own promising transport system not unlike European 'shuttle.' In all probability this will be a ship of far lesser size than the Buran. And what about the Buran itself? Specialists are hoping to continue its testing. But it has its problems."

[A photograph from the section files shows one of the workshops of the Tushino Machine Building Plant. Those who work there have gloomily dubbed it "the graveyard of the Burans." Today the situation has remained essentially unchanged.]

Ukrainian Policy on Use of Former Soviet Space Facilities Discussed

937Q0020A Kiev HOLOS UKRAYINY in Ukrainian 16 Oct 92 p 7

[Article by General Manager of the National Space Agency of Ukraine Volodymyr Gorbulin, Commander of Antiaircraft Defense of Armed Forces of Ukraine Mykhaylo Lopatin and Chairman of the Space Research Institute, AN Ukrayiny [the Academy of Sciences of Ukraine], Academician Yaroslav Yatskiv under the "Society" rubric: "To Progress - via Space"]

[Text] Ukraine is a space power, a member of the UN Committee on Peaceful uses of outer Space. It has developed an S&T and industrial base which had been formed during execution of virtually all space programs of the former Union. But while performing the role of an executor of programs directed from the center Ukraine has not gained experience of a customer and organizer of space projects, has not created her own information and coordination system and has not established direct contacts with world's leading space powers. It is only now that the National Space Agency, Academy of Sciences, Ministry of Defense and other agencies of Ukraine are beginning to discover for themselves the "space kitchen"

The work has begun - a national space program is under development, and several important interstate agreements on joint activities in the field of space research and uses have been prepared. At the 35th session of the UN Ukraine announced to the world community her intentions as to participation in international space projects. At present the "space property" located in the Ukraine territory is being inventoried. However, the new political situation has also created new problems. One of them is control of space, and particularly the use of antimissile offense [per original] systems in the interest of the defense of Ukraine and development of her S&T and economic potential. Here arises the problem of relations with certain circles of Russia. Not to be proofless we shall present here the opinion of the chief of the press service of the space forces of Russia Colonel Rodionov: "**The sudden intention by Ukraine to create her own space control system is such an example** (the **authors**' note: this has to do with Russia's "space migraine" with respect to states' sovereignty).... **She only has one optical and two radar stations near Sevastopol and Mukachevo. She has neither specialists nor an information acquisition center. To judge from everything there is an aspiration to become the third (after the USA and Russia) country that owns such a prestigious strategic system**". Here is another quote: **"Ukraine has claimed her exclusive right to the facilities of this** (meaning "ground space") **infrastructure in Yevpatoriya and near the town of Dunayivtsi"**. It is somewhat strange to read such opinions of a Russian Colonel. He is talking about Ukraine's property—the property that one must treat properly (together with Russia and other states involved in the "space pie" of the former Union). However paradoxically this may sound, processes of declassifying the information that up until recently was classified have created additional difficulties for the development of the space sphere. At present there are a lot of rumors and fears, particularly among residents of Transcarpathians, concerning the Mukachevo radar station (RS), which is one of the most important sources of aerospace information and a defense facility of our state.

The economic operating mode of the Mukachevo RS and using it for basic scientific research were discussed in great detail at the Academy of Sciences of Ukraine. After long discussions scientists together with representatives of the Ministry of Defense had concluded that the Mukachevo station is a facility that is important for constructing a model of the ionosphere over Ukraine's territory, studies of the universe in a sensitive telescope mode, etc. Professor Yu. Yampolskyy, an associate of the Radio Astronomy Institute, AN Ukrayiny, proposed another method for using the RS. He found that when the station operates in a highly sensitive telescope mode, all ecological problems related to the use of high power emitters of radio waves are eliminated. The thing is, studies of the near space and particularly of its ionized component, the ionosphere, are of utmost importance for radio communications, calibration of navigation systems etc. Besides, the Earth ionosphere is a very sensitive tuning fork that responds to various natural and man-made phenomena - solar eruptions and magnetic storms, earthquakes, hurricanes and chemical and radiological contamination.

After a scrupulous discussion of the problem of the Mukachevo RS representatives of the Academy of Sciences and Ministry of Defense of Ukraine decided to approach the government of Ukraine with a proposal of joint S&T and defense-related use of the station. It was also proposed to study problems of foreign scientists' participation in these studies and of creating an international space research center in the Transcarpathians. As far as Russian Colonels' hints regarding Ukraine's aspirations "to become the third (after the USA and Russia) power that owns a prestigious strategic system", we do not make a secret out of it - there is such a desire. This is not about ambitions - rather an urgent need of Ukraine, a space power. Because nowadays space research is an enormous incentive for S&T progress, a sphere of new international contacts, and after all it is a step towards civilization.

Government Financial Support Urged for Conversion of Space Sector Enterprises

937Q0056 Moscow TRUD in Russian 29 Dec 92 p 1

[Article by Mikhail Chkanikov: "We Were Still Making Rockets...: The Creators of Launch Complexes Are Near the Financial 'Finish Line'"]

[Abstract] Recently, I had occasion to meet Vladimir Yeliseyev, the deputy general designer of the Moscow-based Design Bureau of General Machine-Building. Behind the insignificant sign of that design bureau hides a once powerful firm whose activity could be spoken about or written about in the past in veiled hints only. Because the Design Bureau of General Machine-Building creates the ground equipment and the launch complexes for the space sector's rockets.

The design bureau is headed by Academician V. Barmin, who—along with Korolev, Glushko, Pilyugin, Ryazanskiy, and Kuznetsov—was commissioned to explore space. Under his guidance, launch complexes have been created for the Vostok, the Proton, and the Energiya/Buran.

Not too long ago, when the space program was the pride of the Fatherland and flights into orbit were proceeding one after the other, the design bureau's staff members were quite properly considered the elite of the engineering corps. But today, with launches being rare, the existence of the design bureau itself is being threatened. Nearly 40 percent of its staff members have left in recent years. They have left to earn money. Yeliseyev explained: 30-year first-class specialists at the design bureau earn 4,000 rubles [R] a month; the young staffers get less than R2,500.

It would seem that preserving a staff of veteran specialists would benefit the state no matter what. Yes, going aloft when many in the country are living below the poverty line is extravagant. But it would be no less expensive to destroy a sector that was created with an immense amount of labor and the investment of colossal monies and the efforts of the best minds in the Fatherland. All you need to do is pay designers no less than a living wage, and then one fine day, when we're ready to go back into space, they'll have something to report about for the money that was "eaten up." For godssakes, the money spent on wages is, in any case, next to nothing when you compare it not only with the amount of money it would take to resurrect the space program out of the ruins, but also with the amount of unnecessary spending that goes on today.

True, if we were to proceed from the notion that the country of Tsiolkovskiy and Korolev will never be able to rise above the level of a sales booth, then we could forget about saving the creators of unique equipment. But, at the Design Bureau of General Machine-Building at least, they feel that professional designers will soon be needed. And they are trying as best they can to preserve the staff.

Yeliseyev spoke about how various space technologies can be used in strictly ground-based activities. He pointed out, for example, an electric space heater that does not burn oxygen and therefore presents on fire hazard at all. No matter what you say—it's a good, useful everyday appliance. But here's the question: does it make sense that, as a result of conversion, the "rocket scientists" are forced to design fireplaces, and the tank plants are forced to knock out pots and pans?

Still, wouldn't it be better for each to be doing what he was supposed to be doing? The plant in Dubna, for example, switched over to the manufacture of SU sports planes (designed by the Sukhoy Design Bureau, where several generations of combat aircraft have been created). Orders for the new aircraft have been coming from Western countries. And the professionals, keeping their skills up, are doing what they know.

The second version seems to me to be more promising. But a template, in my opinion, could be the conversion of the Moscow Kremlin. The onetime military fort has long ceased to be such. But over all these years and no matter what the regime in power, an entirely peaceful, not to mention worthy, use has been found for the Kremlin. After all, if it had occurred to anyone in, say, the 18th century, to turn it into a stable or a grain storage facility—out of dire necessity—then, mind you, we would be able to contemplate it now only on etchings.

I shared my reservations with Yeliseyev, and he was mildly offended. It turns out that there are some very complex developments in the making at the design bureau, but there's not much interest in them. The designers, for example, had already gone to the Russian Ministry of Fuel and Energy's Committee for Electrical Power Engineering with a proposal to outfit the heat-and-electric power plants with electronics. The plants generally have obsolete automated process control systems. But the Design Bureau of General Machine-Building has created electronic automated control systems that are very reliable. After a little reworking, the launch-complex control systems could be used at the power plants.

The Committee for Electrical Power Engineering did not respond at all to the design bureau's proposal. Apparently, the people in the committee feel that the reliability and safety of the electric power plants do not represent the most pressing problem right now—they can work a little longer with the old equipment.

On that score, I'll allow myself a little prediction. In one of our first interview sessions, the new premier of the Russian government, V. Chernomyrdin, gave me to understand that he would attempt to stop the degradation of heavy industry and would return a high priority to the production of the means of production. Such a program could be assessed in various ways. But it is clear that its realization will summon additional demands for electrical power, the load on the stations will grow, and new stations will have to be built. Then the demand for electronic control systems will become pressing, and they will be purchased abroad.

We've already had some experience with that kind of import. At the Perm Gas/Turbine Electric Power Plant, the third and fourth power-generating units are equipped with foreign electronics. A contract concluded in 1988 cost 100 million German marks

"Our system is hundreds of times cheaper," says Yelisevev "and its on a par th foreign systems in terms of reliability "

It wouldn't make sense to advertise the automated control system created by the Design Bureau of General Machine-Building. All the same, domestic commercial enterprises are, right now, frightfully far from electrical-power production. Western enterprises would hardly be interested in Russian electronics, but our power engineering sector is not rich enough to outfit power plants with new instruments The only way to use the potential of "space" designers in a normal way here on the ground is to set up government programs, finance them out of the state budget, give them state protection and special credits. That could hardly be more expensive than paying for out technological backwardness with dollars in the near future

NPO Lavochkin Officials Discuss Conversion, Diversification Program

937Q0038A Moscow VOZDUSHNYY TRANSPORT in Russian No 42, Oct 92 p 12

[Article by I. Polyakov, VOZDUSHNYY TRANSPORT correspondent: "Space Company Route to Reform": the first paragraph is an introduction]

[Text] The Scientific Production Association imeni S. A Lavochkin is one of the subdivisions of the military-industrial complex. By what means does the military-industrial complex now exist? How does it fit into the economic reform? Nikolay Laptev, chief engineer Aleksey Rodin, first deputy general designer, and Aleksey Yuryev, chief designer, those people who themselves directly implement the programs, speaking frankly, of diversification, that is, the production of military and civilian goods simultaneously, participated in a discussion of this theme held recently at the scientific production association

Financial Support

Correspondent: The military-industrial complex is receiving increasingly fewer military orders. A reduction in military production and discharge of workers are problems very familiar to many enterprises in the complex. What civilian projects, in your opinion, may have a positive impact"... We are still talking about a market mentality

A. Rodin: Changes in the company began in 1988 and were associated with well-known events: the first meetings between Gorbachev and Reagan and signing of the agreement on eliminating medium-range missiles. At that time we understood: it was necessary to undertake decisive, effective measures. Military doctrine had changed. The directions in which there were scientific-technical accomplishments were taken as a basis for future commercial projects. For example, space communication We already had operative spacecraft in stationary and high elliptical orbits on which it was possible to install relay equipment Working on the Mars and Venera projects such problems had already been partially solved and information had been relayed from other planets. It was no accident that we received a technical assignment, an order from the Bank of Russia for establishing a communication and data transmission system for the "Bankir" financial information system The project makes it possible, for example, to transmit any conceivable volume of information from Vladivostok to Moscow in a few hours

Correspondent: The concerns of the financiers are understandable: the volume of operations in banking organizations, according to estimates by specialists, has increased by two or three orders of magnitude, the equipment in large part, naturally, is outmoded and well-trained people, as always, are in short supply

A. Yuryev: Among the other developments it is possible to mention the development of a complex system for supplying information services to Tyumen Oblast ("Nord system"): voice mail, telephone, telegraph, Fax, Telefax and exchange of information among computers. The postulated annual profit is about one billion rubles. Contracts were signed with the NIPEK corporation and the North Stream Company for establishing such a system for the West Siberian region of the country as well. The projects were intended for supplying a wide range of information services for this zone and its connection with other regions of Russia, the CIS, as well as Western Europe and the United States

A. Rodin: Projects also are being worked up for the development of a space system for air traffic control at the level of modern standards. A reduction in the extent of flight routes and integration into the world system are economically advantageous. For example, simply on the servicing of one flight route the saving may be up to 45 thousand dollars

N. Laptev: We feel that still another interesting project is the development of the "Tekos" automatic space technological system. The objective is to obtain, under microgravity conditions, superpure pharmaceuticals and semiconductor materials and the implementation of fundamental and practical research in the field of materials science. The idea is as follows An SS-18 intercontinental missile will be used in putting into orbit a space system consisting of an orbital module and a returnable vehicle. Putting it briefly, all possible kinds of technological processes will transpire in the vehicle. In short, the program will make it possible to achieve first-class results in advanced technologies: microelectronics, laser and microwave equipment, medicine and biology. The shareholding company Kosmicheskaya industriya [Space Industry] was organized for implementing the program and a small workshop was set up for the production of strains—biological products. As you see, we are carrying out several civilian projects; under market conditions, it goes without saying, you cannot survive on a single program. To this I add that together with Glavkosmos in the United States we are presenting commercial exhibits of our technology: Lunokhods, Vegas, Veneras, and we are earning hard currency

All Countries Are Our Guests

Correspondent: Nevertheless, what is done by the company is in large part secret with a capital S

N. Laptev: As a matter of fact, we never were a purely military company. Today military orders make up 50 percent, programs of the Academy of Sciences—20 percent and the rest is commercial activity. If these relationships and these

concepts are taken into account, we remain a state enterprise I mention as a detail that scientific programs (such as the Vega and Fobos projects) were developed in cooperation and close collaboration with scientists and specialists in the United States and tens of European countries. Today all projects of such a type are usually international.

Correspondent: Your company developed the lunar robots, the lunokhods, the Luna, Venera and Mars. The Vega explored Halley's comet and its nucleus...

N. Laptev: ...The spacecraft on its trajectory took a look at the morning star.... Among the new projects: the Granat automatic space observatory was developed in collaboration with the engineers and scientists of Bulgaria, Denmark and France. It is studying the stars. Professional astrophysicists are carrying out highly precise observations in a broad range of radiations. Foreign specialists are imitating our experience in developing returnable capsules, engines and heat regulating systems. Interest in the association has increased, as indicated, in particular, by the pilgrimage of delegations from all ends of the Earth: both French and Italian and Americans, Japanese and Chinese.... Others come from pure curiosity: what is going on, they say, in Russian rocket technology? Still others arrive with specific proposals. That's something which enables us to look to the future with assurance and hope. Western companies at times are competing with one another. For example, two of them have expressed the desire to participate in the development and construction of one of the types of spacecraft engines and have asked that we be partners. That company was selected which proposed the most economical project.

In What Direction Will Development Go?

N. Laptev: The most important thing for us, those who are in charge of the operations, it goes without saying, is the problem of keeping busy, creating new jobs, organization of shareholding companies and the formulation of new commercial projects. The administration knows the cost to the group, to ourselves, and insofar as possible is striving for a solid position of the association in the rocket-space industry of the country. The average wage is 4800 rubles; for a professional reamer, for example, it is up to 15,000-20,000. Talented, innovative development- design specialists, engineers, test personnel and technologists also earn such a wage. However, I repeat, the average wage is today less than a market basket—5100 rubles. The poor nation for the time being cannot ensure its citizens, in particular, our association specialists, an adequate life. For example, the wage level, set by state regulations, is 2800 rubles.

You Can Be a Millionaire If You Know What To Buy

Correspondent: I warn you in advance, I'm going to ask a provocative question: is this voucher business good or bad?

A. Rodin: The idea of issuance of vouchers in itself is reasonable, but in actuality it was not well thought through and has come to be an absurdity.

Correspondent: That's exactly right. It's not clear what you do with the check. As devoted card players say, what's the deal? Will a specialist of your company be able to spend the check-voucher in acquiring a share of the Scientific Production Association imeni S. A. Lavochkin? On the other hand, the actions of the powers that be are not characterized, let's put it gently, by an adequate consistency: suddenly Chubays can declare that the ruble exchange rate for the check is 250 000 rubles.

N. Laptev: To be sure, the nominal value of one unit is 10,000, a pitiful amount for a poor person. For that sum he possibly can acquire a medium-quality pair of boots.... So we recently received a paper from a government office: recalculate the value of the fixed capital assets—it increases by one or two orders of magnitude.

A. Rodin: The plant is appraised at 200 million rubles and there are 10 thousand workers. With the former value of the capital assets and the nominal value of the checks the company specialists will be able to secure the controlling block of shares. Without delay I will exchange my check and my wife's check for two shares.

Scientific Production Association imeni S. A. Lavochkin—A Company of the Future

Correspondent: Thus, you already in part have begun to deal with new market stimuli. In particular, I have in mind additional pay for specialists when they are employed on commercial projects. How will you operate later under free market conditions?

N. Laptev: I will begin by saying that our association has very strong intellectual and industrial resources, a solid planning-designing and laboratory testing base and modern computer capabilities. The prerogative of the company is scientific experiments and the execution of technological processes in space, ballistic-navigational support and in-flight control of space robots. Thus, the company is able to handle any tasks. I will briefly mention those services (some of them were mentioned earlier) which we can offer to our partners: launching of satellites and putting them into a designated orbit, development of automatic space systems for solving different types of problems (for example, low-orbit communication services, ecological monitoring...), as well as conducting all kinds of scientific experiments (fundamental research in materials science can be mentioned). The price is 20 percent less than the world level. We also are ready to consider other commercial proposals. The foreign and Russian partners who invest in the projects will become shareholders.

Contact telephones: Moskva, 251-92-49, 575-50-01, 575-50-02.

Commercial Satellite Systems Under Development at NPO Lavochkin

937Q0042 Moscow MOSKOVSKIYE NOVOSTI in Russian No 45-46, 15 Nov 92 p 6

[Article by German Lomanov, under the rubric "Conversion": "NPO Lavochkin Is Launching Money Into Space Russia's Leading Space Firm Is Realizing a Whole Array of Promising Civilian Projects, Attracting Private Investors in the Process"]

[Text] In the Russian space program, the NPO S. A. Lavochkin has traditionally been involved in interplanetary flights. That the firm has an excellent reputation goes without saying—its work history includes at least seven world-class pioneering achievements (the first artificial lunar satellite; the first soft-landing on the Moon; the Lunokhod, celebrated in its time; the delivery of lunar soil back to Earth; the first Venusian satellite; soft landings on Venus and Mars). Its defense work (the creation of data-relay satellites) was never advertised, but the firm has much to be proud of in that area, too. The instability of science-related and military orders forced the NPO to seek out its own niche in the market. True, the facility in Khimki, near Moscow, like all the other defense enterprises, has been manufacturing lamps, tourist items and other consumer goods, but the firm's officials knew that expanding such "conversion" would not improve its financial position very much. Which is why, over the past two years, a whole array of large-scale commercial programs that fall within the firm's area of competence have been developed. According to our information, NPO Lavochkin has no serious competitors in the market area of large investment projects involving space-based communications systems. And rather small cost-recovery times are involved—one and a half-three years—especially since the possibilities of long-term extraction of profits are very high. Finally, also serving as a guarantee to investors is the fact that none of the space-based communications systems of NPO Lavochkin takes a back seat to NASA's and the European Space Agency's best equipment in terms of reliability or data transmission rate. Today, we present the most interesting of those projects.

Bankir. The aim of the Bankir project is to introduce paperless technology into banking. British experts estimate that the changeover from paper to real-time electronic clearing transactions is equivalent to a growth in the national product of 5-7 percent. NPO Lavochkin is working right now on a system of interbank satellite communications. Three Kupon satellites (modified military vehicles) will be placed into geostationary orbit 36 km [sic] high by Proton boosters. Geostationary orbit is attractive in that the angular velocity of vehicles in that orbit is identical to that of the Earth, which means that the satellite is always "suspended" over the same point on the surface, making it very convenient for radio-signal relay. The jewel of the project is a repeater that is equipped with a phased-array antenna. The antenna sends to Earth 16 radio beams, each of which covers an area on the surface 1,200-1,500 across and is capable of carrying immense volumes of data. Moreover, the electronic system for controlling the antenna can instantly re-aim a beam from one region to another. Say, it's still night in the European sector, while it's already daytime in the Far East—several beams could be re-pointed to the latter, in order to increase the systems capabilities in that region. There are no such satellite systems abroad as of yet.

Bankir serves more than 40,000 users, and all financial clearing transactions are done in real time, or, to put it simply, instantaneously. The signal travels not only from one bank to another, but also to the Central Bank of the Russian Federation, which opens the possibility of second-by-second monitoring of all the money in circulation in Russia. The traffic capacity of the system is so great that all the banks in Russia would take up only about 15 percent of it, and the communications channels left over could be sold to other clients. The Kupon satellites are slated for launch in late 1993/early 1994. The project is being financed by the joint-stock company Global Information Systems, whose founders include the Russian Federation Central Bank, the Association of Commercial Banks, NPO Lavochkin, and the Zelenograd NPO Elas.

Nord. The Nord project is geared to the regions of the Far North, where those involved in the extraction of petroleum, gas, and gold have virtually no modern, rapid communications. It is difficult to erect radio relay links on the permafrost, and they would be much more expensive than space-based repeaters, which are to be installed on four modified military satellites. They will be placed into an elliptical orbit with an apogee of 42,000 km by the illustrious, but slightly modified "No. 7"—the rocket on which all the Soviet cosmonauts "rode" after Yuriy Gagarin. Ten-beam repeaters provide simultaneous telephone communications for 53,000 users. The system will serve not only stationary receiving stations, but also mobile stations, which can be installed in trains, automobiles, and airplanes. The repeaters and the ground equipment are being developed by defense institutes that have a great deal of experience in the creation of military communication systems: the Moscow Scientific Research Institute of Radio Communications will handle mobile facilities, the Scientific Research Institute of Radiophysics will handle stationary facilities. But why do we need new satellites if the long proven Molniyas are flying in almost the very same orbits? Unfortunately, the Molniyas can't be used in this system because they rotate about one of their axes, which means that the antenna would not be permanently aimed at a given region. There would be interruptions in communications that would be more or less tolerable in normal conversations, but would be less so in business communications and completely unacceptable in fax communications. The NPO Lavochkin satellites will be stabilized in three axes, and the radio beams relayed by them will be precisely fixed to the proper regions.

Development of the NORD satellite is being financed by commercial structures. Local authorities of the northern regions have also shown an interest in the system—NPO Lavochkin has signed protocols of intent with the administrations of Tyumen, Kamchatka, the Komi Republic, and the Khanty-Mansiysk and Yamalo-Nenetsk okrugs. The repeaters are slated to be placed into orbit in 1995. A temporary, simpler version is under consideration—i.e., outfit the satellites with an already existing 3-beam repeater, rather than the 10-beam repeater, which still has to be developed. There would be fewer channels, but plenty for the first stage of deployment of the system. Such a version would be cheaper and could be launched as early as 1994.

Zerkalo. The Zerkalo project is a large communications project that is being run and financed by the Moscow-based commercial firm NOOS Space Technologies, which has already invested nearly 300 million rubles [R] in the project. Zerkalo is expected to provide high-speed exchange of computer data. A beam from a communications satellite

"illuminates" a very large area on the Earth's surface and is diffused, as it were, which means that the signal is too weak for transmitting large blocks of data. The Zerkalo project proposes putting into geostationary orbit a satellite with a repeater that will send to Earth 10 independent, focused beams pointed at some business region. The ultraprecise "tie-in" of the beams will make it possible to get by with a receiving antenna 1.5-2.5 m across, something that any office can install on its roof. Launch of the Zerkalo satellite is planned for 1995.

Lavochkin (Tekos) represents the second area of commercial activity of NPO S. A. Lavochkin—a production area. Long-duration missions aboard Soviet orbital craft have amassed unique experience in the manufacture of the most diverse materials and preparations in weightlessness. The unusual production environment is enabling fundamental breakthroughs in medicine, biotechnology, microelectronics, and laser and UHF equipment. In space, one can produce ultrapure standard preparations and semiconductor single crystals that are uniform in structure and properties and can be used for the production of highly integrated chips. The products of space-based industry are very highly valued on the world market, and no one can compete with Russia in that type of production (recall that the American shuttles go aloft for only about a week at a time, whereas our orbital stations stay up for years). The firm has become the head developer of the Lavochkin space production complex, which will consist of an orbital module and a return module capable of bringing back to Earth 900 kg of materials produced in orbit. In order to development the complex, the joint-stock company Space Industry was created; it includes the very largest defense-related structures: the Yuzhmash Design Bureau and the Yuzhnyy Machine-Building Plant (the SS-18 booster), the Center for Space Biotechnology and NPO Rotor (techniques for producing biomedical preparations and protein crystals), the Nauchnyy tsenter [Science Center] concern, the Scientific Research Institute of Materials for Electronics, the Scientific Research Institute of Molecular Electronics (technology for producing semiconductors), and NPO Khartron (control systems). The joint-stock company intends not only to sell the preparations and materials produced in space, but also to make the Lavochkin complex's onboard production units available to customers for experiments. One will even be able to reserve space in the complex's workplace for one's own equipment.

Vehicles will be placed in orbit (at least four a year are planned) by the SS-18 intercontinental missiles, which were removed from the our arsenal in accordance with the agreements to reduce strategic offensive weapons. That cheap launcher will reduce considerably the cost of the project, making it possible to set prices at roughly 20 percent below the market. The project has attracted the interest of several foreign firms, but they would like to have government guarantees. A month ago, government decree RF N820 came out, providing for a number of measures for the efficient use in the national economy of military missiles that are scheduled to be eliminated. One would hope that that decree will give some measure of additional assurance to potential investors.

At the NPO these days, only the most severely cut orders of the Russian Federation Ministry of Defense and the Russian Academy of Sciences (the interplanetary probe Mars and the Spektr and Prognoz research spacecraft) are being financed by the budget, and they account for 63 percent of the volume of production. A firm that, like our entire space program, existed on state orders only, has managed in two years time to find financing for a third of its operations. This year, commercial structures have invested nearly R1 billion into the NPO's projects. The operations are going forward on that, but the NPO is open for collaboration. Solid investors have the opportunity to invest their capital—thereby accelerating the creation of space-based communications and production systems—and to make a profit.

Telephone NPO S. A. Lavochkin (095) 575-56-04, 573-90-56.

Areas of Activity of NPO S. A. Lavochkin (in percent)

Area	1990	1991	1992
Military	50	45	40
Science	45	45	40
Commercial	5	10	20

Bankir Communications System

Number of users	
local bank divisions	40 000
regional divisions	150
regional clearing centers	40
international banks	100
international clearing centers	10
Number of Kupon satellites	3
Satellite mass	2,650 kg
Altitude of orbit	36 000 m [sic]
Period of rotation	24 hr

Nord Communications System

Satellite mass	2,300 kg
Repeater mass	600 kg
Number of satellites in system	4
Number of users served	8 3000
Number of communications channels	8 000
Channel traffic capacity	32 000 bit/s

Lavochkin Production System

In-orbit spacecraft mass	5,500 kg
Parameters of circular orbit	
altitude	580 km
inclination	97.6
Active life in orbit	24 months
Power-supply voltage of onboard gear	27 V, 60 V
Parameters of return module	
total mass	2,000 kg
payload mass	900 kg
diameter	2.4 m
payload space	4 cu m
level of microgravity	0.00001 g
electrical output capacity	4 kW
g-loads during reentry	12 g

List of Products Manufactured Aboard Lavochkin Vehicle

Name (purpose)	Quantity per mission
Interferon, insulin, tumor necrosis factor, hepatitis B vaccine, growth factor (treatment of viral diseases, diabetes, cancer liver, wound healing)	2 types of preparation, 50 g each (1 million therapeutic doses are produced from 1 gram)
Gallium arsenide single-crystals (microelectronics)	100 kg (ingot mass 4 kg, diameter, up to 80 mm)
Sulfide, cadmium selenide and telluride, zinc oxide, epitaxial structures of silicon (micro- and optoelectronics, laser equipment, and IR and UHF equipment)	20 kg

Results of International Aerospace Conference Discussed

937Q00394 Moscow VOZDUSHNYY TRANSPORT in Russian No 43, Oct 92 p 10

[Article by Yu. Stepanov and A. Trutnev, VOZDUSHNYY TRANSPORT correspondents: "Space Today and Tomorrow"; the first paragraph is an introduction]

[Text] The First International Aerospace Conference was held in Zvenigorod. Its initiators were the International Engineering Academy, Russian Engineering Academy, Russian Academy of Sciences, Ukrainian Engineering Academy, Ukrainian National Space Agency and others.

The matter of bringing together the efforts of scientists and engineers of different countries for the implementation of space programs in man's interests is today exciting many people. That is why the scientists of Russia and the Ukraine, engineers working in the field of cosmonautics from 63 companies and organizations, decided to participate in a discussion of the future of cosmonautics.

In opening the conference Academician B. Gusev, president of the International Engineering Academy, laureate of the State Prize, presented a welcome to its participants from A. Rutskiy, Russian vice president. "The leaders of the Russian Federation," he stated, "are steadfast in thoroughly facilitating the development of aviation and cosmonautics, the priority realization of scientific research in the field of rocket-space and aviation technology."

Among the conferees were V. Kovalenok, flier-cosmonaut, Lt. General of Aviation, Yu. Koptev, general director of the Russian Space Agency, Academicians K. Frolov, V. Utkin and others, as well as scientists and specialists from the United States, Germany, France and Taiwan.

"Singly used rockets were the basis on which the former USSR was able to reach the leading place in space conquest," said G. Lozino-Lozinskiy, general designer and director of the Molniya Scientific Production Association. "But today it has become evident that the employment of singly used rockets is becoming increasingly more costly. It is necessary to take a series of measures for a substantial reduction in their cost. Both the Americans and the Europeans and the Japanese have now thought about this. For example, indeed, even the launching of such a perfected system as the Shuttle costs from 300 to 500 million dollars. A reduction in the cost of a launching will qualitatively change the possibilities for using space. A changeover to the development and employment of multiply usable space systems is only natural. We developed a project for a multipurpose aerospace system (mnogotselevaya aviatsionno-kosmicheskaya sistema—MAKS). As its basis there is a two-stage system for putting vehicles into orbit. The first stage is an An-225 basic aircraft and the second stage consists of a multiply usable orbital aircraft and a one-time use fuel tank. The MAKS is capable of performing a series of missions for which there was no solution earlier: the possibility of ensuring emergency rescue of objects in orbit, assembly of large objects in space from modules and monitoring of adherence to international agreements in the space field, including with respect to military activity. The MAKS can serve the purposes of collective security....

The Aerospace Section of the Russian Engineering Academy, of which G. Lozino-Lozinskiy is academician-secretary, is exerting efforts in order to organize mutually advantageous joint projects with foreign countries and is maintaining communication with foreign engineering academies, companies, corporations and international organizations.

"The Russian aerospace industry has unique development work and achievements behind it which may be of practical interest for Western countries, Japan, India and China," stated A. Yakovlev, chief scientific secretary of the International Engineering Academy, to VOZDUSHNYY TRANSPORT correspondents at the conference. "The introduction of these attainments will enable foreign companies to obtain a substantial economic advantage, to reduce time input and expenditures on the development of promising projects, to ensure savings in energy and raw material resources and to increase the quality of fabricated items by use of the latest materials, technological processes and individual copies of equipment. For Russia cooperation in the aerospace industry field should provide definite hard currency income required for overcoming critical situations, saving jobs for highly skilled specialists and stabilization of the economy.

Such cooperation will enable continuation in Russia of mutually advantageous research and development in the space conquest field.

During the three working days of the conference its participants worked in seven sections: on problems in the development and efficiency in employment of multiply usable space systems; winged space systems; aerodynamics and dynamics of flight of aerospace systems; engines; materials and technologies; navigation and control systems; electrical equipment; biomedical problems of space flights; professional activity of a crew.

The open character of the conference will favor a strengthening of trust and broadening of international cooperation.

The conference facilitated definition of the overall strategy for leading aerospace companies, scientific research institutes and other organizations and assurance of profitability of space research. A general result of its five-day work was competent recommendations on the Russian national space program.

Prospects for Russian Aerospace Conversion After Moscow Conference

937Q0029 Moscow TRUD in Russian 14 Nov 92 p 2

[Interview with Yuriy Aleksandrovich Kalugin, director of production at the department of general machine-building of the Russian Ministry of Industry, by Yu. Popov: "Secret Shields Opened"; first paragraph is source introduction following three are lead-in to interview]

[Text] **An international conference on the conversion of the aerospace complex, held under the aegis of the UN in Moscow, at the Russian Academy of Administration, brought together nearly 500 leading designers, almost the entire complement of our defense sector, and dozens of prominent foreign specialists.**

The conference began with a sensational exhibition of models of ekranoplanes—aircraft that have been developed by Russian designers in which the wing is the broad fuselage itself and that can soar low over seas and plains with a minimal expense of fuel. And it ended with a report that, although released to a small circle of people, was no less sensational—about an impending contract between the department of general machine-building, top secret until recently, and the well-known American firm Pratt & Whitney. They are negotiating the joint production of space-vehicle engines based on the world's most powerful propulsion system, which put Buran into near-Earth orbit.

That report has already rung wide in Kaluga, where a group of conference participants went—the entire Icarus was made up of just foreigners—to acquaint themselves specifically with the products already being manufactured by the general machine-building enterprises as a result of conversion. I can testify that the military-industrial complex, so costly for all of us, is squeaking along, but nevertheless is retooling for peaceful products and, in addition to the firm's orbital stations, is ready to put out on the market other useful things—from engines for small tractors and a set of equipment for producing cheese to extremely delicate medical equipment and what one would think would be attractive to the amateur mechanic, a compact tippler hoist for passenger cars.

Here are the figures that Yuriy Aleksandrovich Kalugin, the director of production of the department of general machine-building of the Russian Ministry of Industry, used to represent the sector's changeover to peaceful production.

KALUGIN: The manufacture of so-called consumer products has traditionally accounted for a large percentage of output at our enterprises. But a substantial shift has taken place since last year, when 41.5 percent of output consisted of military products and 58.5 percent consisted of civilian products. Plans for this year called for raising the percentage of civilian products to 70 percent, but it's already clear at this point that that figure will be 78 percent. In 1993, the figure will be 85 percent. The reason for that are very specific programs miscalculated at the plants and calling for an immediate transition to dual-purpose technologies—defense and [mionyy]—recommended at the conference.

But that transition will take as much as 15 billion rubles [R] of capital investment a year. The Russian government is loaning us half that amount. Where will the rest come from? We are proposing to foreign partners that if they want a profit, invest dollars. If they doubt that, we will carry out conversion without them. Our estimates are that we will create capacities for R110 billion in products in 1995. If they help us, the figure will be twice that. They must understand that the caravan is under way, and whoever hooks up with it early can count on a bigger profit.

That had to be explained at the conference, because initially it was as if we were speaking different languages: the foreign specialists pressed for general truths about the benefits of conversion, but finally came to understand that we had to talk about specific contracts. If there wouldn't be any American dollars, well, they could offer Australian dollars. Latin America, Asia, and the Near East are ready to cooperated in that regard. And we are ready to cooperate, in any fashion—in consortia, small enterprises, joint ventures...

TRUD: But will there be such an economical choice for your collectives? As we know, the possibilities for privatization in the defense sector are limited.

KALUGIN: That's being provided for, it's being provided for. But I'd like to emphasize this: neither conversion nor privatization have to signal the collapse of anything. Otherwise, there would be unemployment and social upheavals. The transition must be prepared for. This year, we've managed to avoid a sharp drop in production and massive layoffs and we've kept as many as 85 percent of our people. Preferential government credits are necessary not only for restructuring technologies, but also for creating new workplaces—more than 200,000 were added in the sector—and for retraining. And privatization? We have a list—150 structural units before 31 December will not be privatized according to the well-known ukase of the president. Beginning 1 January that list will be reviewed. Those enterprises that remain, so to speak, tied to the treasury must be ensured a full load. The rest we are releasing for any commercial business.

TRUD: And in which of those production places would you advise we invest our vouchers?

KULAGIN: Wait until 1 January. I mean, if you have to wait, you have to wait. And maybe take a look at where foreigners are investing their hard currency. At the conference, of course, no contracts were signed—only recommendations were worked out. But it was interesting to observe what equipment animated the foreign guests. Their desire to look at our space vehicles close-up was understandable. But take motors from the Kaluga Motor Plant—how could they have interested Daniel Gallik, an economist from the U.S. Army's agency for arms and disarmament? He not only examined them and the connecting assemblies from every angle, he also took prospectuses describing the unique system for tilling the soil with them. Could it be true that there are no such things in America?

"There are," said Gallik, "but not as many. So I decided to have a close look at yours. The purpose of my visit is not only to study the problems of conversion, but also to study the possibilities of creating joint ventures."

God willing, as they say, we'll cooperate with the Americans for mutual benefit not only in space orbits, but also on the nourishing ground. As for orbits

The secret shields of our defense sector are finally open today. And a great benefit that can be expressed with quite specific economic figures can be brought to the entire world by combining the scientific and design fantasies of the descendants of Tsiolkovskiy and Korolev with the refinement and the efficiency of the SDI technologies developed by those continuing the work of Edison and Ford.

Achievements of Space Medicine Research Not Being Made Widely Available

937Q0040A Moscow VOZDUSHNYY TRANSPORT in Russian No 43, Oct 92 p 10

[Article by S. Omelchenko, cosmonaut-researcher, VOZDUSHNYY TRANSPORT correspondent: "Ilinskaya Reveals Secrets"]

[Text] Familiarization with Yelena Ilinskaya, senior scientific specialist in the laboratory for training and rehabilitating cosmonauts of the Institute of Biomedical Problems (IBMP) has become an absolute must for some Civil Aviation flight specialists. Particularly for those who have been relieved from flight duty by departmental medicine decisions. They have been able to return to work.

The laboratory has unique apparatus and the latest clinical-diagnostic methods, including electromyostimulation, vibro-, electro- and vacuum massage, with a high level of efficiency making it possible to carry out treatment and prevention of a great many diseases, to eliminate fatigue and to restore performance. The very same apparatus has been installed aboard the Mir orbital complex.

It was developed taking into account the advances in physiology, space, aviation and marine medicine. Problems involved in continuous isolation, psychological incompatibility of crew members, restriction of motor activity and comfort during prolonged flights were taken into account.

For example, the electrostimulation method was tested initially in a pressure chamber and then by military fliers on a real flight from Moscow to Kamchatka. The electrodes were sewn into the underwear and the instrument was supplied current from the aircraft network. The crew virtually did not sense their usual fatigue on this flight. In response to the question as to how they felt the fliers stated that they were all ready to fly back, whereas usually they were ready to hit the sack.

Yelena Ilinskaya was convinced that electrostimulators with a set of programs for different muscle groups, supplied with their own power source, were needed by the crews of civil and military aircraft, air controllers, operators of nuclear power stations, drivers, typists, vendors and milkmaids. They are needed on expeditions, on sea ships and for those on watch duties. Portable instruments should be accessible to every family.

Unfortunately, industry has not put such instruments into standard production. The secrecy policy which spread to all development work associated with space is largely responsible for this. Good heavens, only recently there was silence everywhere outside the walls of the Institute of Biomedical Problems on the attainments in space medicine! In vain Ye. Ilinskaya strove to make her candidate's dissertation on methods for the electrostimulation of muscles available to the public. This was opposed by the central board. Someone's vigilant hand wrote, without appeal: "For Official Use." The dissertation was interesting, but who would gain from it?

But, indeed, there is a possibility for assisting spinal patients, invalids. During the time of equipment tests and testing of different methods surprising results were obtained. Those who had been operated on for the repair of extremities walked correctly more rapidly and the virtually hopeless received hope. But the experiment ended and the equipment was carried away. A leakage of information abroad was feared and in fact access to the advances in space medicine was withheld from our citizens, incidentally, those citizens who for three decades had without a complaint borne space expenditures on their shoulders. In the United States this sort of thing is impossible because it is against the law, according to which space research must yield a profit.

The secrets became fewer. But now there is no money. However, if it is calculated how much is spent on those suffering from different forms of osteochondrosis and radiculitis, arthrosis, arthritis, myositis, and disturbances of the digestive and genito-urinary systems, asthma and allergic states, avoidance of which would be helped by the methods and apparatus developed at the Institute of Biomedical Problems, it is clear that much can be saved by the mass production of apparatus.

These very same methods can be used in livestock production for increasing milk yields and growth in the productivity of breeding stock. The racehorses which we export lose a lot of weight on the way to the border. But it is precisely that weight at the border which determines the value of the animals. Ye. Ilinskaya knows how to be of help

in this unfortunate situation. There are methods which can be used in building up muscle mass.

Incidentally, the equipment with which she works can be used successfully in "fashioning" the human body. As desired, to remove fatty tissue and smooth out wrinkles where it is necessary, but also where it is necessary it can be used in building up muscles.

One can only be surprised that with such possibilities Yelena Ilinskaya consents in our day to accept a salary of 1300 rubles, plus another 300 for her academic degree, in order to be able to work in her favorite science. Sometimes in her inner self she declares that she will leave the institute open up a business, begin to make women beautiful and cure men of impotence. But in her heart of hearts she knows that she never wants to leave as long as she can do something more in her job.

More and more Civil Aviation flight specialists are coming to see her. At times time, people and equipment are in short supply. And it is not easy for clients to get to the Institute of Biomedical Problems. Whereas from Sheremetyevo this is along the road to Moscow, from Domodedovo it's not so simple.

But even today the Almos Company, which specializes in the conversion of space medicine and the introduction of its innovations into popular health care practice, is ready to offer to all who desire it the "Restoration" ["Vosstanovleniye"] apparatus, precisely the same equipment as in the laboratory for training and rehabilitation of cosmonauts directed by Ye. Ilinskiy and as in space on the Mir orbital station. The company can supply complete outfits or individual instruments, put locked medical cabinets in place at enterprises, in institutions, in dispensaries and in medical-sanitary consulting rooms and provide guaranteed servicing of the equipment and training of specialists. The cost of the entire "Restoration" outfit is 350,000 rubles and training in courses for masseuses lasting three to five days costs 10,000 rubles.

Anyone who places a high value on human health, who is interested in upgrading the reliability of work by operators and in reducing the probability of occurrence of injuries highly appreciates the contributions of space medicine.

Importance of Russian Space Program, Future Projects Stressed

937Q0012 Moscow KRASNAYA ZVEZDA in Russian 2 Oct 92 p 1

[Article by Col Valeriy Baberdin, cosmonaut-researcher: "Russia Was, Is, and Will Be a Great Space Power"]

[Text] It was a difficult beginning for us. Going without the right foods, not having enough to eat, we forgot about everything else and built cosmodromes, developed rockets, and dreamed about flights to other worlds. That's in our Russian nature. And then it happened. We were the first to burst into the shoreless ocean of the Universe, and we opened the space age to mankind, surprising the entire planet with our scientific, technical, and organizational potential.

I remember how at school when I was in second grade they halted the classes, and we poured out into the hall to listen to the TASS report on the radio about the launch in our country of the first artificial Earth satellite in the history of the world. And then, night after night, armed with—who knows where we got them—binoculars and telescopes, or just with the naked eye, we peered up into the sky, trying to find among those fixed but winking stars that solitary, speeding object that had been created by human hands. And how we greeted the first cosmonauts, how we dreamed of becoming spacecraft testers, designers, and scientists.

Today, unfortunately, very few can name the names of those who right now, at this moment, are standing watch on the orbital station. But then, that's probably natural. The profession of cosmonaut has become more commonplace in the public's mind. It is something else that is unnatural. Why have we suddenly stopped dreaming, why do we think only of today, never looking to tomorrow?

The space program, of course, requires some extremely big spending, and our diminishing budget is forcing us to count every ruble, even though [illegible] we do now. And the thoughts enter everybody's minds that we should "cut back," "pinch our pennies." But [illegible] perhaps it would be good to recall the saying "Penny wise—pound foolish." We might save on space research today, but then we could suffer inconceivable losses in the future.

These days, some intense work is going on in the Russian Space Agency—a draft is being prepared for the distribution of the budget for space programs up to the year 2000. It's being generated in a great deal of part through the joint efforts of leading organizers of the space industry, scientists, designers, and economists. I've had occasion to be on hand at the working sessions of the budget group. I assure you, the topic of conversation [illegible] are not grandiose, all-engulfing ideas. Just the opposite, everything involved the minimum, the efficient, the practical. The main thing was that we must survive and demonstrate that the space program can help the economy [illegible]. When the "Draft for the distribution of the budget" [illegible] is compiled it still has to be defended in the government and in the parliament. And then it can be reported. That's the way [illegible] nowadays.

Specific programs. We have them. Take the Rus Dyuna—they involve launch vehicles and the improvement of their design. Mir-2—the [illegible] orbital station. Spektr-Rentgen-Gamma—that's a project for a new space observatory that is assumed as a colossal international cooperation. I could go on and on.

But we have a different kind of problem. A great many strategic missiles are being eliminated from [illegible]. It would not be beneficial [illegible] to destroy them. There are some interesting proposals for using those missiles as systems for delivering miniature satellites into near-Earth orbit. The launches could [illegible] be performed from mobile launch complexes.

I often hear [illegible] something like this. How can they be flying up there in space [illegible] collapse and disarray but everything is [illegible] work with [illegible]

They're even taking foreigners up, and the foreigners are delighted—with the organization and with the equipment. Yes, thank God, the space sector is still holding on. It's holding on thanks to what it has achieved and to the high level of reliability of its system, thanks to the obsession of the people who build the rockets and the spacecraft, who ready the launch pads and support the launches, who support the training of the cosmonauts and their stints in orbit. And so many of them are military. Their lot as officers is not easy—the units are scattered about the entire former Soviet Union. Moving five, or seven, sometimes even 10 times, they have to do their duty the whole time. But then, that's part of the arrangement.

Russia's baggage includes some unique experience garnered with the mind, and then with blood and sweat. No wonder it's so highly regarded by specialists from America, France, Germany, Japan, India. And those who have flown with our cosmonauts are truly delighted—and they want to go aloft again, and not just as passengers, they want to do serious joint work in science, in the interests of everyone on Earth. Yes, space brings people together. It brings them together for work that is constructive. And the role of Russia in that should be a leading one.

Lack of Funds Limits Russian Presence at World Space Congress

937Q0014A Moscow NEZAVISIMAYA GAZETA in Russian 21 Oct 92 p 6

[Article by Aleksandr Bolonkin (United States): "The World Space Congress Was No Triumph for Us. There Was No Russian Exhibit"]

[Text] The last World Space Congress, which was held recently in Washington, was the largest during its entire history. About 5000 leading scientists from almost all countries of the world participated in the congress. About a thousand reports, which were read in different sections of the congress, had been selected from among the many tens of thousands of reports submitted. The organizers of the congress were the International Council of Scientific Unions and the International Astronautical Federation. The International Academy of Astronautics, American Institute of Astronautics and Aeronautics, the American National Aeronautics and Space Administration (the famed NASA), the American Academy of Sciences and others also served as co-organizers.

The congress was financed by aviation and space corporations and organizations: Boeing, Grumman, General Dynamics, Douglas, Lockheed, ABM and others. It was organized because the 44th UN Session declared 1992 to be Space Year.

Many famous scientists and developers of space technology attended and spoke at the congress. In particular, one of the leading space technology theoreticians, Academician B. Raushenbakh, Academician V. Mishin, replacing S. P. Korolev in the post of General Designer after Korolev's death in 1966, Academician Yu. Semenov, the present General Designer of the Energiya Scientific Production Association (developer of the Energiya rocket and the Buran spaceship) and Academician R. Sagdeyev, former director of the Soviet Space Research Institute, attended from Russia.

After the American landing on the moon in 1969 the glory of Soviet cosmonautics somewhat lost its luster, but nevertheless its contribution remained extremely significant for many years.

During the 1980's (1980-1989) the USSR annually launched an average of 95-125 satellites, which exceeds by a factor of almost 5 (!) the number of satellites launched by all other countries in the world, including the United States (16-27 launchings annually). For example, in 1987 the USSR put 95 vehicles into orbit.

Up to 1 January 1990 there had been more than 2000 launchings of satellites of the Cosmos series alone. It is true that 70 percent of them were for military purposes.

Since 1976 the USSR has annually thrust 450 tons of freight into space, including approximately 20 tons into interplanetary space.

In late 1988 the USSR had launched 66 crews into space, each consisting of 2-3 persons, including 30 joint international crews.

Soviet cosmonauts have spent more than 5500 man-days in space, equivalent to 16 years of continuous flight of one cosmonaut.

However, in Russia the space industry is on the verge of a total collapse. This year Russia is planning to launch only 19 satellites, or four or five times fewer than in preceding years.

This year, for the first time, Russia, one of the two leading space powers, did not participate in the exhibition at the World Space Congress. The fee (300 dollars per square meter of exhibition area) was simply too much for Soviet space enterprises. Most Soviet scientists were able to come to the congress either due to the assistance of foreign sponsors or because of their relatives and friends living abroad. It was painful to see how outstanding specialists and professors were forced to ask the sponsors to reduce the fee (300 dollars) for participation in the congress.

China, however, found the money to reserve an extensive part of the exhibition hall, brought five large models of their rockets and displayed their space technology at the level of Western standards. Mishin, who once had taught the Chinese Chief Designer the principles of rocket designing, spoke bitterly of the absence of a Soviet exhibit.

With respect to the United States, their plans for the further development of astronautics are considerable in scope. These plans are primarily associated with the large space station Freedom, the study of the Earth's natural resources from space and the use of automatic vehicles for studying distant planets of the solar system. Plans for the more remote future include establishing settlements on the moon, manned flights to Mars and organizing energy-generating and industrial enterprises in space.

IKI Director Galeyev's Leadership in Space Science Attacked

93Q0001A Moscow SOVETSKAYA [illegible] in Russian 27 Oct 92 p 3

[Article by I. Podgornyy, [illegible] physical and mathematical [illegible] Leadership"]

[Text] SOVETSKAYA ROSSIYA [illegible] October, by publishing an article by V. R[illegible] entitled "Ivans, Forgetting Istolkovsk[illegible] important discussion. No one can overemphasize the [illegible] Soviet Union was the first in space [illegible] when the former head of Hitler's rocket [illegible] German scientist W. von Br[illegible] work in the United States. Despite the [illegible] to American rocket construct[illegible] ellite was Soviet, the first man [illegible] and that our Soviet television camer[illegible] possible to see the far side [illegible]

I suppose that the most imp[illegible] give an analysis of the reas[illegible] in space. But a lag was noted [illegible] state and it began [illegible] nology itself, but in space res[illegible] many years our superior[illegible] seems to me that the VEG[illegible] space vehicles to Halley's [illegible] director of the Space Rese[illegible] of the collapse. Sagdeev [illegible] installing foreign [illegible] Soviet instrument[illegible] light. As a result the V[illegible] test carriers for [illegible] were not the very best.

Then followed a wh[illegible] physics. The most impress[illegible] the Aktivnyy spacecraft [illegible] were not carried out [illegible] which were known [illegible] gone laboratory tests. [illegible] which recurred [illegible] space uncalibrated. Pl[illegible] favorite student of Sag[illegible] passed from the leader's [illegible] It was precisely [illegible] destruction of [illegible] space phenomena [illegible] just been prepared.

Moreover, immed[illegible] VEGAs Galeev [illegible] space of the ph[illegible] predicted in the Sa[illegible] sensational [illegible] Russell in the [illegible] "Galeyev's dis[illegible] "Ksanf" experi[illegible] conditions for the appearance [illegible] Alfven. But Galeyev did not want [illegible] his own section!

The use of instruments unsuited [illegible] activation only in those segments [illegible] Aktivnyy vehicle where the effect [illegible] principle is difficult to attribute [illegible] scientific qualifications of Galeyev [illegible] director from the experiment sev[illegible] spacecraft launching. Everything possible was [illegible] to ensure failure of the important research!

Fortunately for the director of the "[illegible] had fallen into disfavor. Japanese [illegible] afforded him the possibility for [illegible] their similar experiment and [illegible] Precisely such international [illegible] dering of our money for the sake [illegible] participation in the work of a [illegible] instrument for our space vehicle must [illegible] However, the policy of the direct[illegible] Institute in actuality led [illegible] instrument making.

Is it possible in our diffi[illegible] Space Research Institute to [illegible] science in Russia and keep [illegible] objectives are different. I[illegible] Space Research is Limping" (SOVETSKAYA [illegible] journalist cites the assertion by Ga[illegible] "understands that we must [illegible] our Western colleagues." It [illegible] from whose pocket Galeyev [illegible] of these obligations!

It is surprising that the st[illegible] apparatus and the failure [illegible] scientific directors at all [illegible] time proved to be strong [illegible] Russia's policies.

Reports of Ecological Damage Caused by Plesetsk Cosmodrome Discounted

93Q0001B Moscow IKI [illegible]

Article by Aleksandr Petrov, IKI [illegible] collaborator of Arkhangelsk [illegible] Cosmodrome: Facts and Fantas[illegible] Comments" first two paragraphs [illegible]

[Text] I read about the three-tailed cats [illegible] the Plesetsk Cosmodrome in the newspapers. Fyo-Fye Artemova, who, if you believe the envelope [illegible] Ust-Pocha, told about how, after a bath, [illegible] itch horribly—evidently, the water [illegible] rockets." "Everything around there is dying," [illegible] fellow traveler in the sleeping compartment added [illegible] picture: not far from the cosmodrome he had [illegible] his own eyes huge, unidentifiable hairy monstrosities and near them, dead birds. How can there be mushrooms [illegible] outside the window of the train, the poplars [illegible] green, and at Plesetsk, well, you'll see for yourself.

We pull up to the Plesetsk station. The train comes to a halt, and the leftovers of a healthy skepticism leave me with the speed of a rocket. In the gardens, stand the potato tops, absolutely black, with not a single green leaf, as if destroyed by fire.

Underground, secret, mysterious. Scary. The epithets that are bestowed upon the cosmodrome still, even though the curtain of secrecy it stood behind for many years has already fallen.

S. Sergeyev, a senior research associate from one of the cosmodrome's divisions, says this:

"There's nothing mysterious today and never was in the testing grounds' past. In January 1957, government decree No 61/39 was adopted to create a military facility with the code name of Angar. At that time, preparations for the flight testing of the intercontinental R-7 missile were in full swing in S. P. Korolev's separate design bureau. A place had to be chosen for locating the rocket units armed with that intercontinental ballistic missile. The Yemtsa River Valley in Plesetsk Rayon got the call. The high banks and the rocky soil kept farming operations to a minimum. The dense northern taiga made it easier to hide that strategic facility. There's reason to believe that until 1966—which is when satellites began to be launched from the Arkhangelsk region—American intelligence knew nothing about the existence of strategic missile combined units [soyedineniya] in that area.

"In March of 1957, the first four and a half thousand military construction personnel arrived at the construction site. They didn't start putting in the concrete until a year later. Consequently, the soldiers had to get the heavy equipment to the work site by way of the soft, country roads. At the southern testing grounds (now called Baykonur Cosmodrome), tests of the R-7 missile had gotten under way. The first two launches were failures. That was apparently due to the delay associated with the appointment of a combined-unit commander. Order No 01635 wasn't signed until 10 July, which is when Col M. G. Grigoryev, a veteran of the front in the guards, was appointed commander. On 15 July, he signed the order regarding entry into the position. That is the birthday of the missile combined-unit and of the northern cosmodrome of Plesetsk.

"On 30 July 1959, at the southern testing grounds, the first successful launch of the series-produced R-7 took place, and trained units [chasti] were sent to Plesetsk. By that time, the first missile complex was built, and the unit of Col G. Mikheyev began its alert duty."

Somebody will tell about all that in detail someday. About the backbreaking work the soldiers did, about the horrible conditions in which they laid the foundation for the missile might of the then-USSR. We can condemn the efforts of the military leaders to get the launch complexes built at any price and to get speedier reports back to the government. We can be proud of our soldiers and officers, most of whom went to those godforsaken parts not for any self-interest, but honorably and bravely did their duty to the Homeland. Especially since the Plesetsk Cosmodrome now represents Russia's only gateway to space.

But the local residents' attitude toward the cosmodrome has been and still is chary. No one, of course, asked their permission. The land in the region was simply taken away, and several villages torn down, and their residents were resettled elsewhere. People who for ages had gotten their food by hunting and fishing were forbidden to go into the rich forest lands. That, of course, evoked indignation, but time didn't help things out. The people's dissatisfaction grew as a result of the scarce commodities that flowed into the closed city of Mirnyy and as a result of the hazards concealed in the rocket-fuel-laden railroad tank cars that passed through the Plesetsk station. The image not so much of an enemy, but of an unwelcome visitor, gradually secured itself in the people's minds. In addition to that, in 1973 and 1980, there were two accidents that took more than 50 human lives. Rumors circulated that in the Nenets tundra, where the spent stages fall, the reindeer, of all things, were beginning to lose their hair and that the highly toxic rocket fuel, called heptyl, was capable of poisoning every living thing around the cosmodrome.

The military department in those days didn't saddle itself with any explaining to the population. In the minds of the people, the real dangers were mixed with imaginary dangers, and when the resentment built to a certain point, protests broke out. And not just among the residents of the Plesetsk Rayon, but also among those of the Kholmogorsk and Mezen rayons, as well as among those of other rayons. Implacable positions were taken by public organizations and parties, such as the local anarchosyndicalists.

"We demand that the cosmodrome be removed and that we be compensated for our losses," says their "batka," Ye. Avgustinovich.

Pressured by the public, the cosmodrome in 1990 began to remove the scrap metal from the territory, on which there is 16,000 tons of scrap scattered about the various rayons from Arkhangelsk Oblast to Yakutiya. Staging areas that go by the code names of Narvan-Mar and Koyda have already received nearly a thousand tons of rocket stages, their engines, and the doors of nose fairings, which local reindeer-breeders have adapted for transporting and storing cargoes and which they don't want to give up.

By an agreement with the cosmodrome, the Leningrad expedition Eko-Sever [Eco-North] is now in its second year working here. It is studying the soil and the water in places where fuel tanks with residues of heptyl have fallen. The scientific-technical leader of the expedition, A. Bushmarin, told me just before the most recent expedition flew out into the tundra that the maximum permissible levels of heptyl are exceeded many times over in the fresh craters, whereas the heptyl is either within the limits or not found at all in the old craters. Just how great is the danger to people and reindeer? It's too early, of course, for draw final conclusions, but, in the words of Bushmarin, there is no real danger. By the way, the fuel used in the American Shuttles is no less dangerous to humans than heptyl is. But it would be better if there were no heptyl at all in the tundra.

But every rocket stage has 500 kilograms of residual fuel if it's part of a Tsiklon, and a little less if it's from a Kosmos

Of the 19 launch vehicles that have lifted off this year, six ran on heptyl. Senior research associated S. Sergeyev and other ballistics people at the cosmodrome feel that we could prevent pollution of the tundra and other regions completely. How? By channeling the millions of rubles we're spending on hauling out the stages and other spent parts into the introduction of systems that burn the fuel completely before the parts fall to the ground.

In August of this year, working at the cosmodrome was the most recent environmental commission, which included representatives of the most varied of central and local organizations. They did analyses and inspected the launch complexes and the propellant storage areas—anything they wanted to do. The commission's conclusions do not match the categorical assessments of amateur environmentalists. The cosmodrome and the city of Mirnyy, of course, make their contributions to the pollution of the environment. But within the oblast are a good many enterprises to whom the leadership in that regard must be given. Far from the battle with the environmentalists, pilots burn 10 times more fuel in the Arkhangelsk skies than do launch vehicles. Pulp-and-paper combines have poisoned the water in the Severnaya Dvina and its tributaries to such an extent that the health-epidemiological station has even banned swimming. And people have to drink that water! Those examples are not meant to be excuses for heptyl or space scrap metal—they're meant only to point out the truth of the matter. After all, you don't hear any kinds of demands for compensation for the losses caused to people's health by those local industrial enterprises. And in the Plesetsk Rayon alone, there are dozens: a cement plant, a slate plant, a lime plant, a bauxite mine, just to name a few. And how many stacks poison the water and air in Arkhangelsk, where it's not three-tailed cats that are being born, but deformed humans.

Of course, in riding the "space wave," it's simpler to get some sort of benefits out of the government. In principle, they're needed if the thunder of the rockets that are lifting off keep the residents from living peacefully. And the rayon should be compensated for the economic losses caused by the cosmodrome. But you're not going to solve the environmental problems that way. Make every [guilty party] pay for the damage to the environment and to people—from the outdoor boiler shops to the cosmodrome itself. But for that to happen, the cosmodrome itself must be given the opportunity to earn money on its own, and some of the money could then be given over to handle environmental problems and other local needs.

After all, the cosmodrome for now has to play the role of beggar, even though its earns the state hundreds of millions of rubles by putting navigation satellites, weather satellites, and other satellites into orbit. But all that money sits in Moscow, and the number of launches is being cut back. That's the result of not only the difficult economic position Russia finds itself in, but also, to some extent, the many public protests.

But at the cosmodrome they're not interested in increasing the number of launches. Even if you launch Tsiklons and Soyuzes everyday, it doesn't matter—if they don't give you any money, you're there with an outstretched hand. Right now the next launch is being prepared for—on 17 November, a rocket will lift off that will deliver a return module to the United States. In that module will be messages from the Soviet people to the Americans. People in the oblast are aware that businessmen can send advertisements of their products to the United States, but you have to pay a million rubles for every kilogram. What will Plesetsk get from those millions?

"There will be a launch. I don't know anything about any commercial aims," Yu. Zhuravlev, the chief of staff of the cosmodrome, says to me in answer to my question.

So there it is. Just how much of those millions will go to the construction of roads and housing, to the repair of the barracks, to the correction of environmental problems, no one knows. No one knows if any of it will even go to those things.

I wasn't able to find any three-tailed cats. The same for the weird hairy mushrooms. And as for the potato tops, it turns out that not long before I arrived, they were scorched not by rocket fuel, but by the first autumn freeze.

Interests of Russia Said to Be Shortchanged in Space Cooperation With U.S.

937Q0007 Moscow DELOVOY MIR in Russian 15 Sep 92 p 15

[Article by Svetlana Omelchenko, cosmonaut-researcher and DELOVOY MIR science reviewer: "And Again Russia Will Pay"]

[Text] In the fall of the coming year, our cosmonaut will depart on a 13-day flight aboard the Shuttle as part of the American crew. The Ministry of Defense cosmonaut corps recommended the veteran pilot Vladimir Titov, and the NPO Energiya cosmonaut detachment, which consists of civilian specialists, recommended none other than the veteran flight engineer Sergey Krikalev. They will spend a year in the United States, where they will train in the program for the mission. Who will go aloft, and who will be the backup, nobody knows yet.

I ran into Vladimir Titov in Zvezdnyy Gorodok. He had just come back off leave, in a crisp uniform, and I caught him in the sports hall. But Titov looked a little different from what I had imagined someone would look if he were the lucky individual at whom the finger of fate was pointing.

He was very reserved in his response to my question about the forthcoming Russian-American mission: "Just an ordinary flight." He advised that no EVA was planned for the guest.

The Americans will perform an EVA the day after the launch. We mustn't forget that that is the period of acute readaptation. In fact, we've done that, too, but in an exceptional situation. Astronauts don't move about in the craft the way our cosmonauts do on the station. They use a manipulator on the Shuttle, after attaching themselves to the hull. The duties are clearly delineated among the crew. EVA specialists do not have to keep track of the propulsion system or the craft's life-support system. They are met inside [after an EVA], and others help them re-suit and prepare the equipment for the next EVA. There are always

own space program because of lack of money is leaving the booster without work. To resupply their station, the Americans have had their eye on our cargo resupply craft, Progress.

It's not unwarranted to ask what Russia will get out of this collaboration. And now, 35 years after the launch of the first artificial Earth satellite, we still have no law regarding the space program. True, in October, the parliament intends to discuss a draft of one. To date, there's no effective mechanism for transferring to the national economy the achievements of space science and the s pace sector.

We are holding on to our preeminence in a number of areas in space as a result of the inertia associated with an improbable exertion of forces, even a miracle. After all, isn't it a miracle that our scientists haven't lost their ability to create even beyond the brink of survival, where they now find themselves? There's no money for experiments, materials or reagents, or animal feed. The wages of a space medical professional or even of a physician-cosmonaut are barely enough for a pair of shoes and not enough to feed one's family. Which of their foreign counterparts would be able to work nights in the kitchen because there's no room in the apartment to squeeze a writing desk in?

Still, we're a mysterious nation. For 30 years, the Secret stamps hid from our own people—who supported the space program, by the way—the technologies and materials capable of making life richer and easier and making labor in extreme conditions safer. Now we're about to give everything up to outsiders, gratis, and release our science once and for all to the rest of the world.

What could force us now to behave in the interests of our own state?

'Resurs-500' Project Hopes to Stimulate U.S.-Russian Business

937Q0008 Moscow RADIKAL in Russian No 34, Sep 92 p 11

[Article by Nataliya Lazareva, under the rubric "Advertising is the Engine of Progress": "Space + Conversion = Business"; first paragraph is source introduction; last two paragraphs consist of information for interested parties]

[Text] **We continue to publish materials devoted to the unique project "Space Flight Europe-America 500" (see RADIKAL, No 33). The flight will take place in the second half of November. The launch vehicle will lift off from Plesetsk Cosmodrome, carrying the Resurs-500 return module, which will hold advertising materials and product samples provided by our entrepreneurs. On September 7, a press conference was held by the project organizers at the press center of the Russian Ministry of Foreign Affairs, and they reported that the N1 is ready for launch.**

Our Resurs-500 is to splash down with pinpoint accuracy off the U.S. coast near the port of Seattle. It's a special city. We're used to the fact that some cities in our country were and are closed. But the fact that an American city could be (by their standards) a little closed seems strange to us. But that's how it is. Seattle—a city of industry and science associated with the U.S. military-industrial complex—would be considered closed to us. Residing in that very city are the chief competitors for the very technologies that we are dying to put out into the world market—particularly, space technologies.

And so, into that very "hornet's nest" of competitors our brave defense people are getting ready to launch a flight. Well, birds of a feather.... But our fisherman has to demonstrate some excellent fishing skills. For that reason, among the various measures that have been thought up to celebrate with the Americans their national holiday of Thanksgiving, an international conference is planned, called for now "Space. Conversion. Business." Vladimir Bobronnikov, a professor at the Moscow Aviation Institute and a specialist in the consortium Space Flight Europe-America-500, told us about the concept of the conference.

The aim of the conference is to ready ourselves for, discuss, and formulate programs of international cooperation in areas that are important to both sides, like conversion and business. Conversion, in this case, is taken to mean space technologies that, in the not too distant past, the world community wasn't allowed to get near. In concrete terms, highly accurate satellite observations. In that regard, we're talking specifically about the Central Specialized Design Bureau (in Samara), where the space flight project was born and implemented, i.e., the best specialist not only in our country, but possibly also in the entire world. And right now that area is of great interest to the world market of space technologies. Things like highly accurate land surveys, environmental monitoring, satellite communications, in-orbit production of ultrapure substances, navigation services.

The space technologies market? Does such a market already exist? Yes. But we're not just first-graders in it—you could almost say we're still babies. There is already an international space law. In preparing for the flight, the specialists decided to become familiar with it, but they couldn't even find the necessary documents in the Russian Aerospace Agency. They had to search the libraries for it. They found it and studied the law.

So, in that market, we're starting from scratch. In fact, we have high hopes. In the preparations for the flight, there was very little activity on the part of the representatives of the U.S. military-industrial circles, even though it would seem to be an area of research close to them. Ilya Baskin—a member of the council of directors of the consortium and a St. Petersburg entrepreneur who managed to prepare the financial base of the project—noted this: "I think that the Western countries are simply afraid of the scientific-potential in our military-industrial complex. If we enter the market in a civilized way and honestly, we will be able to do a lot for our country."

For that reason, a second, very important aspect of the conference should be the formation of solid trade ties between Russian and American businessmen. As we already wrote, 500 of our entrepreneurs will stay with Seattle families, and direct contact with Americans will probably help build some bridges. Besides, during the conference

[illegible] seminars devoted to the problems of the market are expected to take place.

A [illegible] of the [illegible] invites the search for possibilities to resurrect the Russian-American Trade Company that was so prominent in the past. From our side, archive materials [illegible] have been gathered to our specialists' count that [illegible] may be productive. Great hopes are [illegible] pinned on the possibility of the inclusion of American and Russian [illegible] cross-[illegible] services have [illegible] work to resurrect the company.

[illegible] and shows [illegible] cultural programs [illegible] on the days of [illegible] ship *Mir* [illegible] Kosmos-500 [illegible] lifting the Resurs-500 out of the coastal waters. Going aboard a [illegible] before [illegible] used to be an [illegible] what [illegible] signed for [illegible] what [illegible] that [illegible] prospect.

To those interested in the requirements for ad placement during the space flight Europe-America-500, we report this: the cost of an advertisement covering 1 sq. m. on the launch vehicle is $40,000-$50,000. A sign of 5 sq. m. on the grounds of the Plesetsk Cosmodrome costs 100,000 rubles [R], or $10,000-$20,000. The cost of an advertisement on the surface of any of the various-sized containers located in the return capsule is $7,000-$12,000, or $2.8-5 million.

If you would like [illegible] a sample of your product inside the containers of the Resurs-500 vehicle, the cost will be determined on the basis of weight or volume, depending on the type of cargo (gas, [illegible]). For 1 kg (including the packing) of cargo, the cost is R1 million, or $30,000-40,000 (in rubles including packing); the cost is R3,800,000, or $115,000. Filling the entire volume of a container holding 0.06 cu. m costs about R23 million, or $690,000. Filling a container holding 0.03 6 cu. m costs R14,500,000, or $438,000.

Telephone [illegible]

Project Technical Director Describes Preparations for Flight of Resurs-500 Spacecraft [illegible]

[illegible] PRAVDA [illegible] Europe-America-500, [illegible] of which [illegible] service.

[illegible] place the Resurs-500 satellite into orbit with a message from President Yeltsin to the American people and with advertising commodities from the finest Russian firms.

On the fifth day of the flight, the Resurs-500 will perform a maneuver and set a course for Seattle. Within 24 hours, the ballistics people will forecast the splashdown site in neutral waters off the U.S. coast. On orbit 111, the reentry will begin.

KOMSOMOLSKAYA PRAVDA: Aleksandr Pasko[illegible] won't miss the mark?

BAZLOV: The Samara-based Central Specialized Design Bureau has already prepared nearly [illegible] various spacecraft. The checkout of all the rocket and space systems for the Europe-America-500 flight has been performed according to the program for preparations for a manned vehicle. The sponsors of the project and the developers can rest assured that all the Resurs-500 will deliver the cargoes and messages to the American state[illegible] any "contingency situations." That will be the way it was confirmed by recent tests performed off the Kamchatka [illegible].

KOMSOMOLSKAYA PRAVDA: How did the [illegible]

BAZLOV: The main purpose was to verify the [illegible] for taking bearings on the return [illegible] trajectory [illegible] to design for putting [illegible] advertising [illegible] to shore. The Pacific Ocean [illegible] days [illegible] [illegible]. Three days before the [illegible] Kamchatka [illegible] seas reached [illegible] spheroid [illegible] 2.3 meters in diameter [illegible] already been in space was lifted from [illegible] evening and taken by helicopter [illegible] flight was tracked carefully by radar stations [illegible] international satellite system Cospas-Sarsat [illegible] for the rescue of ships that [illegible] was activated [illegible] exceeded by [illegible] The navy [illegible] [illegible] [illegible] control and [illegible]

KOMSOMOLSKAYA PRAVDA: [illegible]

BAZLOV: [illegible] The [illegible] would round the [illegible] PRAVDA [illegible]

problem loading the return capsule with samples of high-tech products and trademarks of Russian firms wanting to enter the American market. For a kilogram of commercial cargo placed in the Resurs-500 clients paid 1 million rubles [R]. Participation in the prestigious space show and in the fair in Seattle represents a profitable investment for the "talking" cable and effective advertising of goods and technologies. We took the cargoes "in bundles." And whoever didn't submit them to us is already too late. The Soyuz launch vehicle and the Resurs-500 satellite have already departed for Plesetsk.

KOMSOMOLSKAYA PRAVDA: Do the Russian businessmen who "overslept" still have a chance to somehow participate in the forthcoming space show?

[SOZINOV:] Of course, they can place an advertisement of their firm's name on the skin of the return capsule. Not all the spaceboards at the Plesetsk Cosmodrome are taken with advertisements, etc.—but they will be taken by the largest TV companies in Russia, the United States, and Europe. And it is still not too late to arrange a personal trip to the United States—there in Seattle, the famous organizer of the Goodwill Games, Ben Walsh, has promised to organize "Russian Business Week."

[Correction: "92" as in "1992"]

Details of the 'Europe-America-500' Space Project

ROSSIYSKAYA GAZETA

An article by Vasiliy Cheshega under the rubric "Cosmonautics" [R]: "Russian Business Takes a Bold Step"

[Text] Russian businessmen decided to make the space route to the Plesetsk Cosmodrome to the West Coast of the United States a departure point for cooperation between Europe and America in the realm of using space for economic programs of the ground. The rocket lifts off on the "continental" American Earth [illegible] times a year, past Cape Horn to Seattle.

The Europe-America-500 will demonstrate the capabilities of Russia's new space hardware and attract the attention of the public, portfolio investors, and guarantees the emplacement of orders and credits [illegible] for the budget-financed military-industrial complex. Business in Russia. But why was an entrepreneur from Seattle, who began [illegible] abandoned military [illegible] economy.

The event is unique. It represents the first instance in which a cargo will be delivered from the Old World to the New World in a spacecraft. Among the gifts to the Americans are samples of products from various firms, advertising materials, and children's drawings.

"If Russian entrepreneurs are capable of financing the launch of a satellite into space, that's a sign that people can do business with them on the ground, too," said the head of the firm Neva International, our countryman Viktor Yakovlev, who made a sponsor's investment in the project of 20 million rubles [R].

He would have a wish

Aleksandr Bazlov, the [illegible] with the idea for the project and deputy general director of the Foton Design Bureau of the Samara-based Central Special Design Bureau.

"I came up with this project a year and a half ago. At that time it was remembered [illegible] being taken to Baikonur. A lot of people [illegible] but there was no war, there was [illegible] people in whom it aroused hope [illegible] decided a space bridge by the Europe-America-500 as a symbol of the [illegible] waters.

"When the young [illegible] good, capable workers around us, there's [illegible] example of how we [illegible] that we wouldn't lose [illegible] to buy the rocket [illegible]

...But there's money

[illegible]

The military-[illegible]

of space systems of the Russian Ministry of Defense, Col Gen Vladimir Iv[illegible]ov. And naval personnel of the naval search-and-rescue service, under Rear Admiral Gennadiy Verich, will deliver the vehicle after it splashes down to the American shores.

"I hope that everything will go well with them."

A few words

The initiators and organizers of the project are the following: the Central Specialized Design Bureau (Samara, general designer, D. I. Kozlov), the Progress plant (Samara, general director, A. A. Chizhov), the Fund for Social Inventions (chairman of the board and president, G. P. Alterenko), the firm Innovatsiya (president, M. M. Sokolov), the joint-stock company Garant (chairman of the council of directors, I. M. Vaskin), the Sankt-Peterburg Bank (chairman of the board, Yu. I. Lvov), the joint-stock company Russkiy kapital (president, S. V. Kugushev). A number of firms from Russia and the West received the status of general sponsors of the project.

Collaborating with the organizers of the project were the Main Administration for Serving the Diplomatic Corps, the Union of Industrialists and Entrepreneurs of Russia, the International Fund for Social and Economic Reforms, the Russian Chamber of Commerce and Industry, the international fund Novyy Svet-500 [New World 500], the consortium Ekoprom, and a group of commercial banks and state and private enterprises.

- Among the many signs and logos appearing on the hull of the Resurs-500 spacecraft will be an unusual picture. It was thought up by students of the Samara College. The person who drew it is an American animation artist, James Driscoll. The hero of his new animated film is a space dog named Digswell who can dig in one part of the Universe and come out in any other part he needs to. With his companion, a little girl named Daisy, he always does good deeds. Now Digswell and Daisy are heroes associated with a good deed born in Samara. And the inseparable friends look like this: [photo not reproduced here]

From a directive of the Government of the Russian Federation, 14 August 1992, No 1486-r

1. Resolved to adopt the proposal made by the Fund for Social Inventions, the Central Specialized Design Bureau of the Russian Ministry of Industry, the Center for International Business Projects Interbiznesproyekt, and the firm Innovatsiya, approved by the RSA, the Russian Ministry of Industry, the Russian Ministry of Defense, with regard to the [illegible] in November 1992 of an international humanitarian project "Space Flight Europe-America 500."

2. The Russian Ministry of Industry [illegible] the [illegible] (TsSKB) [illegible] Fund for Social Inventions.

3. [illegible] Russian Ministry [illegible] following:

- the prelaunch preparations and launch in November 1992 of the Resurs spacecraft, as well as the control of its flight, as per contract with the Fund for Social Inventions.

- the search for the return capsule of the Resurs-500 spacecraft in the Pacific Ocean and the delivery of its to the designated port, as per contract with the Central Specialized Design Bureau of the Russian Ministry of Industry.

Central Specialized Design Bureau's Attempts to Diversify to Private Sector Projects

937Q0030 Moscow IZVESTIYA in Russian 14 Nov 92 Morning Edition p 2

[Article by Boris Konovalev: "The Samara Columbuses: What's Hidden Behind the Facade of the Space Flight 'Europe-America'"; first paragraph is source introduction]

[Text] **In early morning, 16 November, a Russian rocket is to lift off from Plesetsk Cosmodrome, and it will place into orbit a satellite whose return capsule will splash down near the American city of Seattle. In a symbolic gesture, the route taken by Columbus will be retraced in a new orbit of the historical "spiral"—through space.**

The event is remarkable in one regard because of the fact that the rocket and the satellite are the first to be purchased by young Russian entrepreneurs with their own money. Why did they purchase it? To announce to the planet our readiness to enter the world market. But the event is remarkable in another regard. Namely, that perhaps for the first time, the Samara Aerospace Complex—one of the largest in Russia and, until quite recently, one of the most secret facilities—has been opened to the entire world and is loudly announcing itself.

The individual who came up with the idea of this unusual space flight to America and who registered it in the Fund for Social Inventions is Aleksandr Bazlov, a staff member of the Central Specialized Design Bureau (TsSKB). The design bureau was created in 1958 to develop the success we had had with our rockets. Dmitriy Ilich Kozlov—a true colleague of Sergey Pavlovich Korolev—headed it and has remained since then its general director. To accelerate rocket-building operations, it was suggested to Korolev that he [illegible] of the aviation industry enterprises, and he chose the Aviation Plant No 1 in Samara. TsSKB grew up in [illegible].

[illegible] of the Korolev design bureau—the [illegible] first intercontinental ballistic missile, the R-7—was [illegible] and [illegible] for series production. Based on [illegible] rockets were created—Vostok, [illegible] Molniya. The rocket that lifted Yuriy Gagarin into [illegible] produced in Samara. And even now all the [illegible] satellites are launched with [illegible] have lifted off the [illegible].

[illegible] TsSKB satellites [illegible] that the [illegible] was the first [illegible] techniques for [illegible] in that

field. It's no accident that the NEW YORK TIMES illustrated its story about TsSKB with a large photograph of the Pentagon taken from our satellite.

Without a doubt, one of the chief causes of the fall of the Soviet Union was the overmilitarization of the country, along with the socialist principles of economics. But the paradox is that, amazingly enough, they continue to operate! If for the U.S. military-industrial complex, a government order represents "manna from heaven" and the prosperity of its people, a government order for our military-industrial complex represents "a cross to bear."

"If we do a job that involves a government order," says Dmitriy Kozlov, "our hands and feet, like before, are tied by the standards documentation. For example, I can't pay staff members more than four times the minimum wage. That's 900 rubles [R], which makes a total of R3,600. How can anyone live on that kind of money these days? We [illegible] to pay more to keep the staff around for the state [illegible]. But the state levies fines on us for that. Since the beginning of this year, we have paid R5 million into the budget in fines. It's absurd! It's not true when people say that the military-industrial complex is for the socialist system and opposes the market. No, we are for economic freedom and for efficient management controlled by common sense and not for scenarios of the "theater of the absurd." Whatever doctrine of efficient, sufficient, or necessary [illegible] advocate today, a power the size of Russia must always be aware of the situation not only near its borders [illegible] from them. For that reason, our equipment will [illegible] needed in order for the leadership of the country [illegible] sound decisions. But in addition to that, [illegible] unused reserved for its market-based use."

Conversion for the Samarans is no longer [illegible] a way of life. Which is why it is natural that [illegible] project initiators and the founders of the [illegible] sortium Europe-America-500. Pay R1 million for a [illegible] gram of cargo, if you please, and it will be delivered to another continent. Today, such cargoes are the advertising payloads of entrepreneurs; tomorrow [illegible] scientific instruments or production [illegible]. To implement those ideas on its satellites, TsSKB [illegible] cofounder of a joint venture with a Swiss [illegible].

Seeing the great importance of conversion, TsSKB [illegible] the creation of the association already [illegible] Sovinformsputnik. The idea was as simple as [illegible] bus egg"—use on a commercial basis the [illegible] chives that were gathered for the national [illegible] wasn't a new idea. But it was largely unused. [illegible] had been used. The rest were stamped SECRET [illegible] sputnik and its energetic director M. M. [illegible] to show how nonsensical that is now. [illegible] like a dog in the manger. So recently [illegible] the green light to the use in the national [illegible] photographs with a local resolution [illegible] opens completely new possibilities [illegible] the plotting of ground clusters for [illegible] management, for city designing and [illegible] other fields.

The acquaintance with the Samara aerospace complex has opened the door to yet another worldwide trend, the importance of which is beginning to be recognized to a greater extent in our economy. The socialist economy of the ministry period (there were others, too) based on the doctrine of the benefit of specialization and mass production, planted the "single crop" principle for enterprises and entire regions. Worldwide practice, however, indicates that "omnivorous," multiprofile firms and transnational corporations are more profitable and viable.

The government of N. Ryzhkov tried to move forcefully to [illegible]. The concept of the "insertion" of civilian sectors into defense sectors was announced. At that point, for example, the entire Ministry of Light Industry and Food Production was dissolved. Its shabby enterprises and jobs were willy-nilly distributed among the enterprises of 10 defense ministries, and Samara did not escape drinking of [illegible].

TsSKB [illegible] to the substantive interests of its [illegible] and "[illegible]" enterprises, primarily in scale, of course. After the fall of the USSR, all illusions regarding the possibility of realizing those projects dissipated. But TsSKB [illegible] "one man" bet on several horses. So now cost-accounting subdivisions for the design of equipment complexes for farms and small bakeries [illegible]. And [illegible] jobs, all the subdivisions began to take on assignments for oil people [illegible] and [illegible]. Apart from their [illegible].

[illegible] to establish mutual contacts in the [illegible] and toward became clear that the insertion [illegible] into [illegible] sectors was necessary, and [illegible] had been quite recently considered [illegible] "acts of perestroika."

[illegible] Maksimov [illegible] the director of [illegible] gets, quite rightly, the growth of multiprofile production is a vitally important need. We understand that [illegible] development of mass [illegible] production. We [illegible] market production, we [illegible] entrepreneurship and, along with many [illegible] now we are being [illegible] by series [illegible] of simple things, such as [illegible] and [illegible]. But [illegible] production [illegible] needed.

[illegible]

Space Administration (NASA), for example, is a government organization that has research and design centers, a launch facility, an astronaut training center, and a flight control center. Tens of thousands of people work at NASA, and all of them are government employees. NASA headquarters doles out, on a competitive basis, monies appropriated by the legislature for jobs involving equipment produced by private firms and for research in universities. NASA represents a combining of the government system and private enterprise. People often say, "We don't have to be discovering the Americas." But we do have to!

Origins of 'Salyut' Station Program in Military 'Almaz' Project Discussed

937Q0036 Moscow ROSSIYSKIYE VESTI in Russian 21 Nov 92 p 4

[Article by Dmitriy Payson, under the rubric "Without the 'Secret' Stamp": "'Salyut' and Star Wars"]

[Text] Seven Salyut orbital stations, one replacing the other, have circled the Earth since 1971, thereby proving the "correctness of main road chosen for the development of space hardware." Glorious Salyut and everlasting Salyut are what they ultimately came to be called. But... "The real history of the Salyuts has yet to be written," said Lenin Prize winner Vladimir Pallo in one of our interviews. "So much of it was difficult and dramatic for the designers." And so now, for the first time in our press, words have been spoken out in the open that were found only in rare western articles: "military space station," "space-based reconnaissance," and even "failure." The history of the orbital posts over the Earth is really dramatic. Which is all the more reason to know about it.

Salyut became Salyut literally in the final minute before launch. Before that point, the long-duration orbital station intended for launch on 19 April 1971, was called Zarya. The vehicle was "christened" by the Big Chief himself, Academician Vasiliy Mishin, the Chief Designer. The ground station for tracking the spacecraft had been named Zarya, and confusion would have been inevitable. And even better that Salyut had been Almaz, the manned observation station used primarily for military purposes. And the station had had a different Big Chief, because the Almaz was born in the Experimental Design Bureau of General Designer Vladimir Chelomey. The Korolev firm was involved with the lunar program, forging ahead full steam on it, and it was working on the project for the giant N-1 rocket, which was supposed to put a cosmonaut on the Moon before the Americans.

But the staff at the Central Design Bureau for Machine Building—which is what Chelomey's firm was called, and at its full title—which would later be known as the Salyut Design Bureau, developed a very attractive project. The 20-ton Almaz station was to be placed in orbit by Chelomey's Proton rocket. The Almaz carried a powerful camera, a system for observing the Earth, and two capsules—recoverable containers for quick return of materials, crews, or cargo. Information about [illegible] Seventh Fleet.

Of course, the "space eye," circling over all the continents with nothing to stop it, didn't make the "enemy" too happy, especially since the Americans didn't have anything like it at the time. Anything could happen, and the Almaz developers gave themselves some insurance: by design, the station was to carry an A. Nudelman rapid-fire aircraft cannon. So it was called, simply, but with taste. The station had an original control system and an airlock chamber for EVAs. It would appear again, by the way, on the sixth Salyut only. In the meantime, Almaz, with a docked transport craft attached, stretched 23 meters in length. And by 1970, on the building blocks at the Khrunichev plant there were already 10 virtually ready Almazes. The main holdup was due to the new control system. And in fact, there weren't any insurmountable difficulties. The work was going swimmingly. The first Almaz crews were being trained in Zvezdnyy Gorodok. But, as we known, we don't do anything simply. By 1970, it became clear that we had "lost the Moon." The Americans put a man there first. And the higher-ups—mainly the then-secretary of the Central Committee Dmitriy Ustinov—halted the lunar program. It was decided that the main road to be taken in the development of the Soviet space program would be the program for the development of long-duration orbital stations, especially since the Americans, attracted to the Moon, didn't have time for them. Chelomey's firms was involved with the station at the time. And at the moment of the big decision, the station was not ready. That's what had happened before. And the solution was self-evident: why not make the Korolev people finish Chelomey's Almaz?

Mishin was against it. Back then, the Chief Designer was against orbital stations in general—they had diverted his design bureau from working on the lunar program. But in Korolev's firm itself, many were of a different opinion. Things went all the way to a letter to the Central Committee of the party. And so the story went. As a result they forced the Central Design Bureau of Experimental Machine Building to hurriedly finish the Almaz. All that [illegible] called the command system. They put a control system from the Soyuz spacecraft on the Almaz. The solar panels were from the Soyuz. In place of a heavy transport ship's cargo, it was decided to use the Soyuz itself. The prepared Almaz orbital units were remodeled into the new station. The blueprints were copied. You can imagine the state the Almaz developers were in. In the end they just renamed the station. And the phrase "main road of development" ended up in the social report [illegible] Congress of the CPSU. So OK, on 19 April Almaz Zarya-Salyut finally became Salyut. Eight days later, Soyuz-10 docked with Salyut. Aboard were Commander Vladimir Shatalov, Aleksey Yeliseyev, and Nikolay Rukavishnikov, departed for the station [illegible] Soyuz-10 undocked [illegible] station. The docked unit [illegible] Vasiliy Mishin would say [illegible] Soyuz-10 [illegible] returned to Earth. Aleksey Leonov [illegible] Valeriy Kubasov and Petr Kolodin. Vitaliy [illegible] Commander Gorbatko, Yuriy Romanenko, and Georgiy Grechko [illegible] Vladimir [illegible]

Viktor Patsayev—went up to Salyut. Soyuz-11 was successful in docking with the station. The cosmonauts worked there until 30 June. On 27 June, they photographed the third launch of the N-1 lunar launch-vehicle (and its explosion at 51 seconds into the flight). On the 30th, the spacecraft left the station and went down for a landing.

Dobrovolskiy, Volkov, and Patsayev were killed during the landing as a result of a depressurization of the return capsule. The air escaped through a valve that was only a millimeter across and that didn't open at the right time when the retroengine fired.

But the work in orbit continued. They finally brought Almaz to the point where it made sense. In 1973, Almaz, called Salyut-3, went successfully into orbit. And the fifth Salyut was, in fact, also an Almaz. And Western analysts long ago noted that something wasn't right with the odd-numbered Salyuts. If the crews on the even-numbered Salyuts consisted of a commander who was a military pilot and of a civilian flight engineer from Korolev's design bureau, the crews sent to the Almazes consisted of two military people. In fact, those Almazes were military observation stations. But the Almazes now fly unmanned. They are used to produce unique photographs of the Earth's surface. NPO Mashinostroyeniye makes the photographs available to anyone who is interested—for money. So the Almaz station has put civilian clothes on over its uniform.

ESA Seen Turning to Russia for Cooperation

937Q0033A Moscow IZVESTIYA in Russian 19 Nov 92 Morning Edition p 4

[Article by Sergey Leskov, IZVESTIYA: "European Cosmonautics Seeks Rapprochement with Russia"]

[Text] **The ministers of 13 countries that are members of the European Space Agency [ESA] reached an agreement at a conference in Granada (Spain) to begin to explore possible space projects jointly with Russia calculated for three years. According to preliminary data this agreement will exceed the volume of all the contracts that have ever been concluded with the Russian space industry.**

The all-European space program was formed about two years ago, and it was oriented toward the United States in many important aspects. However, in the past year the managers of the ESA have not concealed the fact that they want to adjust the program in such a way that the European space industry would not only become independent but would also be able to compete with the American. Europe, for example, is being held back in the creation of its own "Columbus" orbital modules by dependence on the ongoing American "Freedom" superstation project.

The complexity of the situation is aggravated by the fact that Germany, which is one of the major contributors to the ESA, has announced a reduction in its contribution to the general budget. As a result it is clear as a minimum that some European ministers expressed their intention to work on the basic segment of the ESA program—the Hermes space plane (the cost of this item was already estimated at $8-9 billion). Hungary, Great Britain, ESA director-general for piloted flights [illegible]

be saved as a result of cooperation with Russia, which possesses great potential in cosmonautics and is experiencing a critical need for large hard currency orders.

As for Russia, intensive work is going on in the leading institutes and design bureaus on the elaboration of strategic directions in the development of cosmonautics up to the year 2005. As Yu. Koptev, general director of the Russian Space Agency (RSA), stated, only after this will a determination be made on the prospects for one or another transport system, space ships, and specific technical projects. The problems facing the ESA and the RSA are in many ways similar. Therefore, the proposal naturally arose of cooperation with the space industry first and foremost in the elaboration of transport systems, orbital stations, and the manned flight program. It is expected that an agreement between the ESA and the RSA for a period of two and a half years will reach the sum of $120 million, a record for Russian cosmonautics, which also includes expenditures on three flights by European astronauts aboard our orbital stations. The agreement should be signed during the January meeting of the managers of the space agencies in Paris.

At the same time, as Yu. Koptev emphasized, it is unlikely that Russia will join the ESA. Among the projects being implemented today in Europe there is not one that is critically necessary to Russia. Moreover, it is hardly likely that orders of the European space industry, which entails about 32,000 work positions, would be lightheartedly transferred to their Eastern neighbor. These complications, however, in no way raise doubts about the tendency itself of Russia and Europe to get together in the sphere of cosmonautics. Given the colossal expenditures on investigative research, it can be expected with a great degree of certitude that mutually beneficial all-European space projects will become a reality.

Deutsche Aerospace Officials in Moscow to Discuss Aerospace Cooperation

937Q0041C Moscow NEZAVISIMAYA GAZETA in Russian 30 Nov 92 p 4

[Article by Zhanna Dolinskaya: "Spacesuit for Emergence into Space"]

[Text] An agreement on a framework of cooperation among [illegible] RSA and the board members of the Deutsche Aerospace AG (DASA Moscow) were signed the [illegible] in Moscow. A delegation headed by Jurgen E. Schrempp, chairman of the DASA board of directors, held a series of meetings in the Ministry of Foreign Trade, Ministry of [illegible] Space Industry, Russian Union of Industrialists and Entrepreneurs, etc.

[illegible] a Memorandum of Mutual Understanding [illegible] Economic Cooperation Agreement [illegible] in the field of [illegible] flight safety [illegible] Russian transport support.

[illegible] Space Station Mir [illegible] Shidlovskiy, commander of [illegible] Europe-USA start [illegible]

venture is possible. In addition, plans call for developing a spacesuit for emergence into open space: the "EVA Spacesuit 2000," jointly with the Zvezda Scientific Production Association.

Dornier - NPO 'Zvezda' Collaborating on Development of EVA Spacesuit

937Q0041D Moscow VOZDUSHNYY TRANSPORT in Russian No 43, Oct 92 p 16

[Unsigned article: "How to Sew a Suit"]

[Text] The Dornier Space and Applied Systems Department of the German Company Deutsche Aerospace and the Russian Zvezda Scientific Production Association are working jointly on the development of a new suit for cosmonauts who will participate in implementing the "EVA 2000" project.

Deutsche Aerospace and the Zvezda Scientific Research Association, located in Tomilino, near Moscow, will carry out research work by contract with the European and Russian Space Agencies.

The Dornier Department, a key organization of a European consortium, since mid-1988 has been engaged in the development of a suit for cosmonauts who, by the mid-90s, when emerging into open space during flight under the "Hermes-Columbus" program, planned for the end of this and the beginning of the next decade.

The Zvezda Scientific Production Association has been engaged in the development and production of spacesuits since the early 1960's. It fabricated the suit for Yuriy Gagarin, who in April 1961 made the world's first flight into space. The suit of the "Orlan-DMA" series, developed by the Zvezda enterprise's specialists, is being used in work on the Mir orbital station.

The French company Dassault and Belgian company Sabca also are participating in the research.

[A photograph shows the spacesuit in the case; it also will be participants in the European "Hermes-Columbus" program.]

Russian-German Plans for Development of 'EVA-2000' Spacesuit

937Q0025 Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 92 p 126

[Article by Ivan Zhuravlev: "EVA-2000—Russian-German Project for an EVA Spacesuit"; first paragraph is source's introduction]

[Text] A delegation of the joint-stock company Deutsche Aerospace AG was in Russia 4-8 November. Deutsche Aerospace AG is part of the concern Daimler-Benz, and several years ago it brought together all the best in the German aviation and space industry to ensure its international competitiveness.

At a meeting in the Supreme Soviet's Committee on Science, Education, Culture and Ecology, the chairman of the board of Deutsche Aerospace AG U. Shrempp and the chairman of the Committee V. Sheynis exchanged [illegible] Space Agency and the Ministry of Economics, as well as with officials of the Energiya and Zvezda NPOs, and that the chief purpose of those talks was to continue the search for avenues of cooperation in the field of aerospace.

This isn't the first time such meetings have taken place between specialists of the two countries, and they have brought definite results. For example, an agreement has been signed for the joint development of an EVA spacesuit—the project is called EVA-2000—by subdivisions of Deutsche Aerospace AG and NPO Zvezda. There is an agreement with NPO Energiya involving the creation of an all-European space station. And U. Shrempp said that as early as the spring of the coming year [1993], joint ventures will be set up that will be closely associated with the implementation of agreements reached between the two sides.

The journalists were also interested in Shrempp's opinion of the prospects of the production of a European fighter. As is known, there has been a good deal of press recently about the fact that the Soviet MiG-29 aircraft that were taken into the Bundeswere arsenal after the unification of Germany already surpass the future all-European aircraft in combat performance, and, for that reason, the aircraft may not be built at all.

However, the chairman of the Deutsche Aerospace AG board said that certain agreements exist between the governments of Western Europe and between the political factions within those countries and that anyone who says that the aircraft will not be built is, to put it mildly, wrong. In Shrempp's words, that fighter is already not the next generation, and it will be developed in such a manner that it will be competitive after the year 2000.

Energomash - Pratt & Whitney Agreement on Rocket Engine Development

937Q0027 Moscow KOMMERSANT DAILY in Russian 29 Oct 92 p 1

[Article submitted by the Industrial Companies Group under the rubric "Russian Technologies in the U.S.": "'Energomash' Has Decided to Send Arms into Space"; first paragraph is source's introduction]

[Text] **An agreement has been signed between the scientific-production association Energomash and the company Pratt & Whitney that calls for the development of an improved modification of the RD-170 liquid-fuel rocket engine in the context of an order placed by the American firm. That was announced on 28 October by the ASES-Moskva company, which represents the interests of Pratt & Whitney in Russia. An Energomash delegation is in the United States at this moment.**

The Energomash association—previously known as the Gas-Dynamic Laboratory Experimental Design Bureau (GDL OKB)—is the leading organization in Russia in the development of heavy-class liquid-fuel [illegible] was founded by Academician V. P. Glushko.

[illegible]

...ower's RD-170, the most powerful engine in the world, and the RD-701, an engine with a fundamentally new design that uses three-component fuel (oxygen-hydrogen-kerosene). That engine is intended for future reusable injection systems.

The Americans are interested in the 800-ton-thrust RD-170 engine, which is at least 15 percent more economical than American engines, which, by the way, has less thrust. According to "Tverdyy znak" reports, a practical result of the signing of the document in the United States concerning the collaboration between Energomash and Pratt & Whitney will be the development in Russia and the sale in the United States of a modified engine that is adapted to American standards. Energomash representatives feel that the delivery to the Americans of the latest engines modified for their needs will enable the transoceanic partners to save time and money. The United States, specialists explain, is behind in the field of rocket engines as a result of the fact that monies were switched from operations involving expendable boosters to the Space Shuttle program.

Telephone: NPO Energomash: (095)573-12-01

Imagery From Russian Military Satellites To Be Sold Commercially

937Q0074 Moscow KOMMERSANT-DAILY in Russian No 1, 6 Oct 92 p 9

[Unsigned article: "Russian Breakthrough in Western Information Market"]

[Text] Russia is ready to sell to the West photographs taken by the newest military satellites.

According to a communication in the Sunday NEW YORK TIMES, Russia is already selling to the West spy photographs taken by Russian military satellites. The use of the latest space hardware is making it possible to photograph objects with a radius of two meters, which makes it possible to examine in detail the layout of a building, the position of an individual piece of a Cadillac.

In the words of a Glavkosmos representative, with whom [illegible] communicated the information in the NEW YORK TIMES requires refinements. The images of [illegible] and in particular the White House and Pentagon are shown were sent to the Washington bureau of a new export product," which Russia intends to supply the world information market.

Many specialists made the photographs and information [illegible] satellites abroad, began in the mid-1980's. However, only until those models of satellites were [illegible] purposes which were not used for [illegible] a resolution of about 5 meters. A [illegible] Russian government, dated 5 August 1992, [illegible] the commercial use of military satellites would [illegible] employed by commercial [illegible] post-Soviet organizations working in the space [illegible] Russia, [illegible] to be carried out. [illegible] and proposals are [illegible] ever done," declared Peter Zimmerman, a reconnaissance expert at the Center for Strategic and International Studies in Washington.

The absence of anything similar in the West gives Russia a definite advantage in this field, and judging from everything, increased interest is actually appearing in the West in the new form of information services proposed by Russia. In particular, representatives of a whole series of American, German, Austrian and French companies have already shown interest in these services.

'Gonets,' 'Globis' Satellite Communication Systems Under Development

937Q0055 Moscow IZVESTIYA in Russian [illegible] Morning Edition p 3

[Article by Boris Konovalov: "Competition Begins in the Satellite-Communications Market," first paragraph is source introduction]

[Text] **Out of all the areas of development of the space program in Russia these days, only one is going through a genuine boom—satellite communications. And changes are taking place there that could have a radical effect on the state of our space program.**

Recently [illegible] sent to Moscow to the [illegible] demonstration [illegible] tions system that is [illegible] and [illegible] Australia, [illegible] of satellite [illegible] detected [illegible] immense [illegible] expert [illegible] to Globis [illegible] a stable link from Moscow to [illegible] presidents [illegible] delegation [illegible] their [illegible]

[illegible]

global satellite-communications system. Radio telephone communications are expected to be added later.

Three NPOs went in to form the Smolsat association, which is creating the Gonets system—NPO of Applied Mechanics, NPO Soyuzmedinform, and NPO of Precision Instruments. Each member of the threesome has its own objectives. Of great importance is the participation of NPO of Applied Mechanics, which is headed by Academician M. Reshetnev. That firm, located in the now declassified city of Krasnoyarsk-26, has created all our communications satellites. Even now, it remains the wheelhorse in the program Rossiya for the development of satellite communications.

The Krasnoyarsk firm has always had a monopoly on the "space segment" of satellite communications. True, the situation is changing. Conversion and a dramatic decline in state financing has forced many firms to turn their gaze to satellite communications. The electronics industry, for example, has begun developing its own communications satellites. NPO Lavochkin, renowned for its lunar, Venus, and Mars vehicles, is also building its own communications satellites. They're certainly giving very little money to science.

And finally, the forefather and recognized leader of our manned space program, the Academician S. Korolev NPO Energiya, has looked into work involving satellite communications seriously. It should be noted that Korolev's design bureau, in its day, created the first Molniya communications satellite. After that, Korolev handed the whole area over to M. Reshetnev and the top secret Krasnoyarsk-26. These days those at NPO Energiya understand that it is very important for them to become involved in commercial projects in order to preserve the manned space program for Russia and beyond.

[illegible] cooperation with enterprises of the defense complex, it has been decided to quickly create the global [illegible] system Orlets on the basis of large geostationary communications satellites weighing as much as [illegible] tons. The ground segment of the system is being developed by the [illegible] Corporation Vympel' with the technical participation of the Academician A. Mints Radio Engineering Enterprise.

[illegible] systems of small communications satellites in geostationary orbit. The system will provide high-quality communications for [illegible] and a system for digital data transmission for the [illegible] industry—in a word, everything that is necessary for the most powerful, modern [illegible] Russia.

[illegible] Krasnoyarsk-based NPO of Applied Mechanics [illegible] is the best system in the world. But is it? [illegible] But that's what [illegible]

The most important thing is that they're not taking a single penny from the budget for now for the new projects. Commercial structures are financing all the work. Not out of largesse, of course. Worldwide experience has shown that every dollar invested in satellite communications brings nearly seven dollars in profit. That's for the developed countries. But how about Russia? Well, right now we have more than a hundred-thousand small populations centers that don't have telephone communications at all.

The Gonets system, for example, is being financed by Rosselkhozbank, which calculates that in the future, it will have at least 300,000 clients—farmers, leasing agents. Not only will they be provided with communications—all the bank's transactions can be handled, too. It's not science-fiction. For the Krasnoyarsk Kray, NPO of Applied Mechanics has already created a system for transmitting bank data via its Gorizont satellite.

The global satellite communications systems now under development will help Russia link up to the world's information space, which is of exceptional importance for the reform of the country. We must not forget that the creation of such systems also solves the problem of the collection of information from ground-based sensors. That would make it possible to keep track, along an entire route, of the integrity of valuable containers, of the condition of toxic or explosive cargoes. It would be possible to instantaneously detect any leaks that occur in petroleum and gas pipelines. Today, pipelines in our country are provided with communications along only five percent of their length.

We welcome the competition that is starting up in the satellite-communications market. The more intense the competition, the better it is for all of us. And the market is so broad and unexplored that everyone will be able to find its own share of the pie there.

Condition of Military Units at Baykonur Cosmodrome

927Q0055 Moscow PRAVDA in Russian 1 Jun 92 p 4

[illegible] Vladimir Kravchenko [illegible] PRAVDA correspondent [illegible] Baykonur and Major [illegible] Kozlov [illegible]

Arrival. I knew Baykonur not from the small TASS newspaper columns. The launches of rockets from the television screens came into my life during two difficult years as an enlisted man. Moving to the orbit of civilian life, I "ached" long for the rumble of the cosmodrome, the endless Kazakh steppe, the black starry nights, and the searing days under the sun. There are 320 such days at Baykonur. I got lucky. I flew in on assignment on one of them for a linkup with the cosmodrome.

Hello, Baykonur! How are things, friend? Hundreds of questions and hundreds of the most contradictory answers.

[illegible]

doesn't matter that you go through the training in the cosmonaut corps. I went through it during my eight days of assignment.

The politicians were the first to start the balling rolling about Baykonur. On 30 December 1991, in Minsk, an agreement was signed regarding joint activity in the investigation and use of space. The presidents of nine Commonwealth republics, through shared investment, were obliged then to supply the subjects and objects enlisted in the execution of the intergovernmental programs associated with the use and investigation of space with the necessary material and technical resources, as well as other extraworldly things.

The program was not fated to get off to a good start. By that time, the army was coming apart at the seams. Enlisted men and officers left the pads at Baykonur en masse for their native lands. The enlisted men were sent on permanent leave, with the prospect of doing further duty for their own republic; the officers submitted requests for transfer.

In February, the military construction units revolted. Calling their deeds a protest against the officers' inhumane treatment of the enlisted men, the construction personnel laid waste to barracks, warehouses, and headquarters. They got as far as the food warehouses. The conflict went out on its own; the enlisted men dispersed to their homes; the officers drove to wherever they could. Of 4,000 people in the officers' corps on the military construction units, 50 are left today. How many thousands of enlisted military construction personnel abandoned their units is impossible to say.

In the meantime, how do you calculate the damage done to the proving ground. Things were smashed, stolen, carried off. This thing is known: the state that a state. February criminal case was tried. Today they have a special investigator. The military construction units are now under the jurisdiction of the Kazakhstan Ministry of Defense. And [illegible]

[illegible]

The new owners didn't turn out to be wealthy enough to invest the needed monies into space. According to the agreement, the Kazakhstan Republic's share in the financing of joint expenditures for maintenance and operation would not exceed 6 percent of the finance means given by the Russian Federation for these purposes. According to the agreement, the right to use the chattel and real estate of the cosmodrome was given over to the military-space units. Put simply, to the Russian Army.

In the unit where I had served my compulsory active duty, the current make up of the enlisted men is Russian and of the NCOs is 50/50 Russian and Kazakh. The family of representatives of other Commonwealth republics are not counted. They just serving out their term. Who will perform the duties and go on alert in the near future is still not clear. Over the fall call-up, which began in September, not a single draftee went to the cosmodrome. The past spring call-up sent zero draftees from Russia.

The May agreement between the two republics and Russia, according to which Kazakhstan and Russia are obliged to "allot enough draftees and officers for the [illegible] Baykonur cosmodrome," have also produced nothing. The Ministry of Defense of Kazakhstan [illegible] people up, and Russia doesn't want to send them. We will serve."

"Draftees from Kazakhstan," explained a Baykonur staff member, Col. L. Baranov, "[illegible] them are arriving. And with them [illegible] arriving, too. Incidents in which [illegible] are rare. Parents sometimes come to [illegible] their child and safely take him back to [illegible] residence. In such cases we institute [illegible] them. But is there any sense in doing this? Not [illegible] there's nobody to judge them. The [illegible] cosmodrome for Russia. It's a big [illegible] draftee's office is Kazakh, the [illegible] so are the police.

Some enlisted men swear an [illegible] people of Kazakhstan.

Does such a statement [illegible] military service? Lieut. Pavlov:

"Right now [illegible]

Four and a half years ago, I left my home unit. When I returned it was painful to see the familiar features of military service. Much has changed. Things have collapsed, broken. Things have been neglected. And everywhere, there are problems, problems, problems.

The unit commander volunteered this:

"In the administrative platoon, we raise pigs. But the Kazakhs don't eat pork. What are we supposed to do now—raise sheep?"

The situation with cigarettes in the units is simply terrible. A pack of Belomoras per person per week. On an enlisted man's salary of 245 rubles [R], you don't really smoke to your heart's content. And if you want to check out the snack bar, you can get a loaf of bread for R11. Fortunately, they don't feed the enlisted men much worse than when I was there. I dropped in for dinner at the enlisted men's mess hall. Friends steered me away from the officer's mess hall. Tarantulas get on you over there.

A nicotine fit for a soldier is worse than anything else. There's only one disease here—hepatitis. Hundreds of enlisted men and officers get it over a year's time. At Baykonur, as one officer friend joked, it's SOP.

SOP, unfortunately, is water shortages and interruptions in the heating. Incentive leaves have been cut back dramatically—the people don't come back. Russian don't want to serve in Kazakhstan, Kazakhs don't want to serve in the Russian Army.

Squad leader Pvt Vladimir Aleksandrov was drafted from Tyumen Oblast. He'll go home soon. Did he like the service?

"I could live and serve here if the conditions were normal. In a year and a half, I haven't been to one concert in a club, haven't had one pass to Leninsk. My favorite pastime is the television and two movies a week. I did go on leave. But I didn't want to stay home and serve there. I mean, all my friends are here, with my job."

Pvt Asylbek Sisabayev has served six months. He swore his oath to Kazakhstan.

"I don't like the service. Bad water, bad climate. Many of my countrymen are also dissatisfied. That's why we've gotten a lot of new Russian friends. We speak the same language. And there isn't any fighting or brawling."

Asylbek's words were backed up by his friend, Pvt Rustam Ulmasov.

"In our squad of nine men, two are from Kazakhstan. I myself—I'm from Kaze." And there are Russians. We stick together. Help one another out when we can. The times are such right now that you can't go it alone for long."

Section chief, warrant officer O. Solovyev, jumped in the conversation.

"I never worry about the people under me. This wouldn't let me sleep. I'd give them more moral and material incentive if I could—good soldiers are priceless."

I couldn't help but recall the "incentives" of my army days. Almost everybody could get leave. We went on pass often, and the seven rubles we got was plenty for cigarettes and bread. We had concerts and competitions every week. Of course not without the help of the political officer. Today, that position no longer exists in the armed forces. There is an assistant to the commander for personnel. His functions are very limited. After the political schools closed, the level of indoctrination of the personnel and the sociopsychological and cultural training of the personnel declined considerably.

The assistant to the cosmodrome chief for personnel, Col A. Orlov said this:

"Indoctrination by order today is inhumane. Nevertheless, commanders have the right to do it. But forming public opinion, keeping track of military discipline, solving economic problems—not every commander is capable of doing those things. What's needed is the status of the deputy commander. In some armies of the Commonwealth, that position has been created already."

With enlisted men, that's understandable. But how about officers? What's their morale like? During my assignment, I had occasion to be with the officers quite often. I came up with my own conclusion about how they felt about the service. Baykonur these days is, as they say, riding on three whales. For myself, I saw three groups of people. The first are those who have nowhere to go from here. Financial, day-to-day, and family problems have begun to draw on them so much that the individual is used to anything and everything.

The second group of officers are, as a rule, the young ones. They're optimists. They believe that the day will come when economic, cultural, day-to-day power will be added to the military might of the cosmodrome. One such officer, for example, is a company commander, Sr Lt I. Sapriga. His relatives and close friends live in his hometown of Stavropol. Choosing a line of work wouldn't be hard, and he has a place to live. But Igor isn't rushing to leave the service.

The third category of officers form the backbone of the cosmodrome—its veterans. They're not leaving for anything. They're stuck. This is where they've raised their children, where they've planted their own trees, where they've built their homes. According to city statistics, on this land seared by the sun, 50 future Baykonur officers have been born to the families of military servicemen. Many of this category of officers, who came here as enlisted men and later became officers, head military units. Among them are Col V. Faykov, Col A. Savelyev, Lt Col A. Maksimov.

Aleksey Aleksandrovich Shumilin, the chief of Baykonur, arrived at the cosmodrome a lieutenant. His weight at the proving ground is indisputable. By the way, Maj Gen Shumilin is a longtime reader of PRAVDA.

"What's the situation today at the cosmodrome?" I ask him.

"Baykonur has an immense future," [Shumilin says.] "I hope Russia will definitely find the money. Collaboration and foreign projects alone give us fairly good revenues. We have signed contracts for joint launches with South Korea, France, Germany, America. Good foundations have been laid. But it's hard to do everything at once."

"Russia can't do without Baykonur. Even if it opens operations at the other cosmodrome, in Plesetsk. Economists estimate that building a similar cosmodrome in the North will take an investment of R60 billion and 10 years.

"Baykonur was built and put on its feet by the entire country. And the country is responsible for it. Whether it punishes or forgives those who, in kindling the political battle, have betrayed the ideals of the Motherland, of conscience, of fairness—only time will tell. But right now, I can't forgive them.

Coup Plotter Baklanov Describes Career in Missile, Space Sectors

937Q0063 Moscow PRAVDA in Russian 14 Jan 93 p 3

[Excerpts from interview with Oleg Dmitriyevich Baklanov, by Aleksandr Golovenko: "The Unknown Baklanov: A Voice From 'Matrosskaya Tishina'"; first two paragraphs are source introduction]

[Excerpt] Recently, the editor of the Zelenograd newspaper GOROZHANE, A. Yegorov, made an unusual request of PRAVDA. "Many workers, designers, and scientists of the city's 'closed' enterprises," he reported, "have often asked that PRAVDA tell us about Oleg Dmitriyevich Baklanov. He is a talented man, someone who has done much for the defense of the country and for the development of aerospace systems. In Zelenograd, he is well known and respected."

Soon after, we sent questions to O. Baklanov in Matrosskaya Tishina, and despite the fact that he did not at all feel well, Oleg Dmitriyevich made time to answer them.

PRAVDA: Oleg Dmitriyevich, Not all of our readers know you well or the section of work for which you were responsible in the CPSS Central Committee in recent years. You were awarded the star of the Hero of Socialist Labor. What was that for?

BAKLANOV: I began working in 1948, when I was 16. After the war, my mother and I stayed together. Things were difficult, so I entered the trade school (they fed me and clothed me there) at the T. G. Shevchenko Plant in Kharkov. There, in 1949, they began manufacturing an aircraft instrument-landing system, and later, aerospace-hardware control systems. At that plant, I "grew" from assembler to general director. While I was working, I went to school, graduated from the institute, and defended my candidate dissertation on laser gyroscopy.

Marshal Nedelin, General Designer Konoplev, and many other comrades died when the rocket exploded at Baykonur. It had the control system manufactured in the shop that I headed. We all felt terrible for a while. Then it turned out that the mistake had been made not in the manufacture of the equipment, but in the way it had been tested at the proving ground itself. We were no longer under suspicion.

I well remember the beginning of the construction of Zelenograd, which got under way at the behest of former minister Aleksandr Ivanovich Shokin. The city was seen as the flag ship of the science and technology of the electronics industry. I won't name the people with whom fate brought me to the city, with whom I was bonded in friendship, with whom I was so lucky to do so much work. I don't think they would be embarrassed; but I can't name them all, and if I left someone out, it wouldn't be proper. All of them were recognized as pioneers.

Whenever we, the workers of the aerospace sector, would received a new task, the first thing we would do was go to Zelenograd, because the success of the job depended 50-60 percent on the scientific-technical research already completed by the specialists here.

The control system for our space home Mir—which has been in orbit for how many years already now—the capacity for its continual expansion with new 20-ton modules, and the proposed docking of Mir and Buran are all made possible by the onboard computers created in Zelenograd in collaboration with many developers from Kaliningrad, Moscow, Kiev, Minsk, Kharkov.

I was awarded the star of the Hero of Socialist Labor when I was still working at the plant for the creation and commissioning of intercontinental missiles. We installed the first onboard computers on them, and those computers made the system as a whole more reliable and controllable.

In 1976, I was promoted to deputy minister of the aerospace sector (Ministry of General Machine Building).

The creation of the Energiya-Buran system and the launch and automated landing of Buran were due to the efforts of a great many workers, technicians, engineers, designers, and scientists. More than 1,200 enterprises throughout all the republics of the USSR took part in that work. The launch and landing were conducted on Kazakhstani territory.

I was fortunate as minister of the head ministry from 1983 to 1988 to be the chairman of the Interdepartmental Coordination Council and chairman of the State Commission on Flight-Design Tests. Which is why it's strange to hear conversations about the inability of our science, technology, and industry and of our specialists and workers to solve problems of the highest level of complexity.

In February 1988, I was named CPSS Central Committee secretary of the defense industry, and in 1990, deputy chairman of the Defense Council under the President of the USSR. [passage omitted]

Further on Use of SS-25 ICBMs for Space Launches

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[Article by Mikhail Rebrov: "Project 'Start-T': The Cosmos and Profit—Compatible Concepts"]

[Text] The SS-25 strategic system requires no introduction. The solid-propellant rocket can carry a nuclear charge beneath its nose cone. It can be delivered over an enormous distance, and with the greatest accuracy. It appears in the "table of ranks" as a menacing offensive weapon. Let me add that in its class, it is the best in the world. By the way, all verbs should now be written in past tense.

No, I am not about to bring up the topic, "If we beat them into plowshares, what will we fight with?". They are now obsolete. And that's just as well. I am troubled by something

else: In the first variant of the Strategic Arms Limitation Treaty all SS-25s taken off alert status were subject to destruction. If you think about it, that would have placed progressive engineering ideas, developed technology and production experience "under the knife." However, luckily fate had something different planned. Reason triumphed, and the final version of the treaty allows us to keep intact that part of the missile system that is not considered to be a strategic weapon. It was at this point that the idea came up to create a space vehicle out of the SS-25 that could insert commercial satellites into orbit. Besides everything else, the project, which came to be called "Start-1," made it possible to retain highly qualified personnel in defense plants and design offices, to solve the employment problem, and to carry out the tasks of conversion extremely effectively.

Such is the prehistory of the project. The history of it itself began over three years ago, and it began with a misunderstanding, or a reluctance to understand. Two former prime ministers (Ryzhkov and Pavlov) refused the request of "supplicants" for capital investments, even though the "Start-1" project promised not only to pay its way but also to make a profit. Now about the "supplicants." These are not adventuristic organizations with a dilettante's understanding of the problem, but substantial firms: the plant that manufactured the SS-25s, the "Kompleks" Scientific and Technical Center, the Moscow Institute of Thermal Engineering, the I.V.K. Joint-Stock Company (it is investing in development), the Barrikady Plant and a precision instrument design office. Understanding came after the August events of last year, the project reached the point of transition "from an idea to introduction," the date of the first launch was scheduled for December (Plesetsk Cosmodrome), and commercial operation is to begin in 1993.

What is the "Start-1" space rocket system? Let me repeat that it is based on a modernized offensive SS-25 missile (a fourth stage has been added to it, such that its total length is 22 m), the "wheeled chassis" of which was replaced by a special transporting platform. The delivery vehicle is assembled completely at the plant, inserted in a launch container and delivered to the launch site by rail, by airplane, or by a seagoing or river vessel. The payload may be inserted into the prescribed orbit directly, or it may be placed in an intermediate orbit, after which the spacecraft's own propulsion unit takes it into its precise orbit. The weight of the payload is 550 kg, and its overall dimensions are 1.3 cubic meters. The range of altitudes of polar circular orbits is up to 700 km.

Specialists distinguish five basic criteria characterizing "Start-1": design simplicity, high reliability (let me note: Several dozen SS-25 missiles were destroyed by launching them, and not one of them failed), convenient transportability, the possibility of launching from any region (from equatorial and northern latitudes, from the ocean shore, and so on), and insertion of satellites into orbits with different inclination planes. We can add to this that the new space rocket system makes COCOM restrictions irrelevant.

Since the project is a commercial one, I attempted to get more complete information on this side of the matter. Here is what I was told by I.V.K. vice president S. M. Zinchenko:

"We found the idea itself of the defense specialists attractive: It was interesting in engineering respects, and highly promising. Analysis of the international space market shows that on the order of 300 satellites built on behalf of different countries are in a sense waiting their turn for a delivery vehicle. The freight charges are high, which is why interested companies seek advantageous partners. Use of "Start-1" will cost a client approximately 10 times less, if we consider market prices. No, this is not a case of dumping—it is one of the advantages of its design. Our hope is that our project will attract the interest of the Americans. They came up with the Iridium communications system, which will require the launching of 77 satellites.

"As far as the future is concerned, Russia's participation in the Iridium program will open up a road for us into the world information and communication system. Moreover the "Start-1" project is only the beginning, one which may be followed by an extremely effective continuation."

I also learned from this interview that the project (one of the documents pertaining to its implementation, No 1521-r, was signed by Ye. T. Gaydar on 19 August of this year) does not require a single kopeck out of the state budget. Moreover 20 percent of the profit goes into the state coffers. The creators of the system and its investors are not looking at just the foreign market alone. They are hoping primarily for orders from inside the country. After all, there are many scientific centers in the CIS that are interested in inexpensive satellites for various sorts of research and ecological monitoring.

Such, in brief is the "Start-1" project. Need I say more? Apparently yes, since certain questions may arise. The first one is this: "Is space now a realm of private enterprise?" Yes, and this is its first shoot. But rather than the "private," I personally prefer another word—"commercial." It is time for us to realize that "cosmos" and "profit" are compatible concepts. That conversion presupposes not only "dismantling," but also creation, and effective use of new products. Another question is this: "Won't our advanced technologies drift away across the border, and won't they be used over there for military purposes (for example, in SDI)?" Clear legal groundwork and monitoring are important here. However, I believe that all of these problems are soluble. And in the meantime, "Start" is approaching the start line.

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